

Printed in the Year 1775, written by the Author.

USEFUL EASY

DIRECTIONS FOR SEAMEN

WHO USE

SHADLEY'S QUADRANT

SHOWING TO



How to hold the Quadrant to take the Pole and the

Observation of the Sun, Moon, Stars, and the Meridian

of the Observations; and also how you may find

the Height of any Object, and when the Degrees are

How to examine whether the Index Glass, and the

Useful Friend

The Meaning of what is called the Dip of the Horizon

the Height of the Pole and the Water, and how

find the Dip by the Quadrant

and how to move it

and how to move it

many other very necessary Things which

are in and out of the Quadrant, and the

Quadrant, though they are such Things as every Seaman

who uses the Quadrant should understand, it is not

likely that he will find them in any other

book of the sort, and it may be very useful to many

others, and it may be very useful to many

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Printed in the Year 1772, written by the same Person

USEFUL, EASY,
DIRECTIONS FOR SEAMEN

WHO USE

HADLEY'S QUADRANT.

SHEWING TO

THE MEANEST CAPACITY,

How to hold the QUADRANT to take the Fore and Back Observation of the Sun and of a Star; and the Meaning of the Observations; and, also, how you are to know when the Sun is up, and when he begins to fall both in the Fore and Back Observations.

How to examine whether the Index-Glass, and the Fore and Back Horizon Glasses stand in a right Posture; and how to set them right when they do not stand right.

The Meaning of what is called the Dip of the Horizon, or the Height of the Eye above the Water; and how to find the Dip by the Quadrant.

The Meaning of what is called the Refraction of the Air, and how to prove it.

Many other very necessary Things, which are not mentioned in any Book of Instructions given with the Quadrant, though they are such Things as every Seaman who uses the Quadrant should understand, if he is desirous of knowing what he is about.

A Book of this Sort has been much desired by some Seamen, and it may be very useful to Many.

*** The Critical Reviewers, in *May 1773*, say, "They believe
" this Book will prove a very useful Companion to the
" industrious Mariner."

Sold by RICHARDSON and URQUHART, under the Royal Exchange; Mr. COLE, Mathematical Instrument-maker, near the Globe-Tavern in Fleet-street; Mr. HUMPHRY, Bookseller, at Chichester; and T. WHITE, at Arundell.

K
THE
SEAMAN'S Useful Friend,
AND
PLEASANT COMPANION.

(Price only EIGHTEEN-PENCE.)

533.e.8

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Besides other serviceable Things this Book shews

The Sun's Declination for 1773, 1774, 1775, 1776, and how, with very little Trouble, to find the Declination till 1800. Rules for working an Observation with the Sun or a Star, more plain and easy than any Rules that have yet been given; and the Examples put down in so plain a Manner, that a Seaman may work an Observation at any Time of the Year, and in any Place, with great Ease.

A List of some of the biggest Stars, and their right Ascension and Declination fitted to the Beginning of the Year 1773; and a short easy Rule to find the Star's true Declination for any Year to come.

An easy Way how a Seaman, if he does not know the Star, yet in a few Minutes he may find the Star in the Heaven, and be able to know the Star always afterwards, as soon as he sees it; so that, if the Weather allow, he may every Night observe with a Star, and find the Latitude of the Ship.

Very easy Rules for mending the Dead Reckoning by an Observation; and the Examples are put down in a plain Manner, and at length.

For the sake of those Mariners who do not know how to find the Variation of the Compass, here is given an easy quick Way of knowing the Variation by a common Wooden-Dish Compass.

How to touch the Compass.

Plain and useful Directions for Ships coming into the English Channel either from the Western Ocean, or from Spain, Portugal, or Bay of Biscay.--- By these Directions the Mariner may know how to make the Land's-End or the Lizard with Safety.

This Book is wrote in a very plain Manner, and such Words only used as every NAVIGATOR well knows the Meaning of.

Printed for P. HUMPHRY, at CHICHESTER;
And sold by RICHARDSON and URQUHART, near the Royal Exchange; F. NEWBERRY, in Ludgate-street; J. FULLER, in Ave-Maria-Lane; and Mr. COLE, Mathematical Instrument-maker, in Fleet-street, London; M. ALLISON, at Falmouth; Mr. E. SCORE, at Exeter; Mr. LAMBERT, at Lewes; J. LINDEN, at Southampton; Mr. BREADHOWER, at Gosport; Mr. HARDING, at Portsmouth; and T. WHITE, at Arundell. 1774.

(Price only \$1.00 per copy)

[illegible]

and the other two are the same as the first two.

[illegible]

The first thing I noticed was that the room was very dark.

...and I am not how to find it
...and I am not how to find it
...and I am not how to find it

...and
... ..
... ..
... ..

3. Unemployment Insurance - This is a tax on employers and employees. It is used to pay for unemployment benefits. The tax is 1.1% for employers and 0.6% for employees. The total tax is 1.7%.

[illegible]



TO THE NAVIGATORS

Desiring to have useful practical Knowledge in easy
Words, and in a very plain Manner.

THroughout this Book I have tried to use such Words only, as the practical Navigator well knows the Meaning of: And I am very sure this Plainness of Speech will not affront THEM. Most Seamen think (and, indeed, many other People think) "No Man writing a Book should, for the sake of shewing his Learning, use such Words, or so put his Words together, that the People for whom the Book is written cannot very easily understand the Book."

Upon trying what is done in this Book with other Books of Navigation, any Seaman who keeps a Reckoning will see that I have had a great Desire to help, and, indeed, it may be said, to be useful to Numbers that do keep the Ship's Way, and also to ALL Seamen who may have a Desire to keep a Reckoning. But although the practical Navigator, by reading over the Title Page of this Book, will know the great Usefulness of this Book to many Seamen, yet I beg Leave to ask any Seaman that keeps a Reckoning,

ing, whether he does not believe that there are a great many Navigators who would be heartily glad of an easy quick Way of knowing a Star to observe the Star to get the Latitude of the Ship, when they have had no Observation of the Sun, some Days, and they are then about making the Land? Whether he does not believe, there are a great many Navigators, that do not know how to take and work a Distance between the Sun and Moon, or between the Moon and a Star, to mend their Dead Reckoning: I say, whether he does not think, such Navigators would be very glad of plain easy Rules that are agreeable to Reason and Practice at Sea, for mending their Dead Reckoning? But to speak a little more plainly about these two Things.

When a Ship is about making the Land, and has had no Observation of the Sun some Days past, an Observation by a Star may save both Ship and Hands. (*See what is said about finding the Latitude of the Ship by the Meridian Altitude of a bright Star.*) This must be one Reason, I suppose, that most Books of Navigation tell the Seamen how to find the Time of a Star's Southing; but they give no Directions how he shall know that Star when he sees it. The knowing of a Star's Southing, only, is of little or no Use to a Seaman that knows not the Star when he sees it. And I may safely say, there are a great many Seamen that can or do keep a Ship's Reckoning, but they are not able to pick out a Star in the Heavens, and use it for finding the Latitude of the Ship; and who will say, that the Time of a Star's Southing, only, will make such Navigator able to find out the Star in the Heavens? To such Seamen particularly this Book will prove an USEFUL FRIEND and a PLEASANT COMPANION; because by the easy Directions this Book gives, they may, in a few Minutes, find the Star in the Heavens, and be able to know that Star, ever afterwards,

afterwards, as soon as they see it; so that, if the Weather allow, the Navigator may, every Night, observe with a Star, and find the Latitude of the Ship.

This Book will, also, prove an useful Friend and a pleasant Companion to such Seamen as do not know how to mend their Dead Reckoning by taking and working the Distance between the Sun and Moon, or between the Moon and a Star (a thing very few Navigators know how to do, in Comparison with the great Number that do not know). The Rules given in this Book for mending the Dead Reckoning are very easy, and agreeable to Reason and the Practice at Sea, and the Examples are put down at length in a plain Manner.

Here are true Tables of the Sun's Declination, made by the Solar Tables of the exact Astronomer MAYER, and by the Help of the Table of the Alteration of Declination, the Declination may be found, with very little Trouble, till the Year 1800.

The Rules in this Book for working an Observation of the Sun and a Star are more easy than any Rules that have yet been given for the Seaman's Use, and the Examples are made so plain, that he may work an Observation at any Time of the Year, and in any Place, with great Ease and Pleasure.

For the sake of those Seamen that have not learned to find the Variation of the Compass, here are shewn, First, a very easy Way of knowing the Variation of the Compass by a common Wooden-Dish Compass; and, Secondly, how to take an Amplitude with such Compass, and a more plain Way of working the Amplitude and of finding the Variation

DEDICATION.

Variation of the Compass, than he will meet with in any other Book.

As the Compass is so liable to be robbed of its Goodness; if such a Thing should happen at Sea, who knows what sad Accidents might follow? Therefore I have given the Mariner full Directions how to touch the Compass.

Enough, perhaps, having been spoken of the Usefulness of this Book to practical Navigators, I shall mention, only, that

Many Years Experience makes me able to say, that Numbers of Seamen want such a Book, and would be heartily glad to have it; and, also, that it will prove what the Title promises, an **USEFUL FRIEND** and **PLEASANT COMPANION**. *Magne est Veritas, et prevalebit*; however censured by the Ignorant or Malicious.



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Plain

C O N T E N T S.

Plain and useful Directions for coming into Soundings from the Western Ocean or from Spain, Portugal, and Bay of Biscay.--- By the Directions the Seamen will be able to know when the Channel is open, and also how to make the Land's End or the Lizard with Safety

P. 6

The Navigator will be pleased to mend these Faults before he uses the Book.

Page 2 of the Dedication, Line 12, read Dead Reckoning.

Page 10, Line 30, read See Page 22.

Page 13, Line 28, under the Words Longitude in East and the Declination increasing, read Subtract the Miles from the Declination.

Page 13, Line 28, under the Words Longitude in West and the Declination increasing, read Add the Miles to the Declination.

Page 24, Line 22, read the Star's Right Ascension in Page 25.

Page 24, Line the last, strike out the Words That is.

Page 47, Line 41, read gives the Number 120.

The Table of the Sun's Right Ascension in Pages 22, 23 marked for the Year 1772, but, the Table is made for the Year 1773.

Note, The Ascension, in some Places, is One Minute too big which makes the Southing of a Star, found by the Table, some times, One Minute sooner than the Truth; but this Fault can cause no Harm, because, the Observer, commonly, allows himself more than a Quarter of an Hour to make the Meridian Observation.

TABLES



T A B L E S

OF THE

SUN'S DECLINATION

For the Years 1773, 1774, 1775, 1776.



A

The Declination of the Sun's Center, when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of Astronomers Day, for Jan. Feb. March, April, May, June 1773.

Days	Jan.	Feb.	Mar.	April	May	June
	South	South	South	North	North	North
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	22 58	16 55	7 20	4 46	15 15	22 9
2	22 52	16 37	6 58	5 10	15 33	22 16
3	22 47	16 20	6 35	5 32	15 51	22 24
4	22 40	16 2	6 11	5 55	16 8	22 31
5	22 33	15 43	5 48	6 18	16 25	22 37
6	22 26	15 25	5 25	6 41	16 42	22 43
7	22 18	15 6	5 2	7 3	16 58	22 49
8	22 10	14 47	4 38	7 26	17 15	22 55
9	22 1	14 28	4 15	7 48	17 31	23 0
10	21 52	14 8	3 51	8 10	17 46	23 4
11	21 43	13 48	3 28	8 32	18 2	23 8
12	21 33	13 28	3 4	8 54	18 17	23 12
13	21 23	13 8	2 41	9 16	18 32	23 16
14	21 12	12 48	2 17	9 37	18 46	23 19
15	21 1	12 27	1 53	9 59	19 0	23 21
16	20 49	12 6	1 30	10 20	19 14	23 23
17	20 37	11 45	1 6	10 41	19 28	23 25
18	20 25	11 24	0 42	11 2	19 41	23 26
19	20 12	11 3	0 19	11 22	19 54	23 27
20	19 59	10 41	N. 5	11 43	20 6	23 28
21	19 46	10 19	0 29	12 3	20 18	23 28
22	19 32	9 58	0 52	12 24	20 30	23 28
23	19 18	9 35	1 16	12 43	20 42	23 27
24	19 3	9 13	1 40	13 3	20 53	23 26
25	18 48	8 51	2 3	13 23	21 4	23 24
26	18 33	8 28	2 27	13 42	21 14	23 22
27	18 18	8 6	2 50	14 1	21 24	23 20
28	18 2	7 43	3 14	14 20	21 34	23 17
29	17 45		3 37	14 39	21 43	23 14
30	17 29		4 0	14 57	21 52	23 10
31	17 12		4 23		22 0	

(3)

The Declination of the Sun's Center, when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomers Day, for July, August, Sept. Oct. Nov. Dec. 1773.

Days	July	Aug.	Sept.	Oct.	Nov.	Dec.
	North	North	North	South	South	South
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 6	17 55	8 7	3 24	14 38	21 56
2	23 2	17 40	7 45	3 47	14 57	22 5
3	22 57	17 24	7 23	4 11	15 16	22 13
4	22 52	17 8	7 0	4 34	15 35	22 21
5	22 46	16 52	6 38	4 57	15 53	22 29
6	22 40	16 35	6 16	5 20	16 11	22 36
7	22 34	16 19	5 53	5 43	16 29	22 42
8	22 27	16 2	5 30	6 6	16 46	22 49
9	22 20	15 44	5 8	6 29	17 3	22 54
10	22 12	15 27	4 45	6 52	17 20	23 0
11	22 4	15 9	4 22	7 15	17 37	23 5
12	21 56	14 51	3 59	7 37	17 53	23 9
13	21 47	14 32	3 36	8 0	18 9	23 13
14	21 38	14 14	3 13	8 22	18 25	23 17
15	21 29	13 55	2 50	8 44	18 40	23 20
16	21 19	13 36	2 27	9 6	18 55	23 22
17	21 9	13 17	2 3	9 28	19 10	23 24
18	20 58	12 57	1 40	9 50	19 24	23 26
19	20 47	12 38	1 17	10 12	19 38	23 27
20	20 36	12 18	0 53	10 34	19 51	23 28
21	20 24	11 58	0 30	10 55	20 5	23 28
22	20 12	11 38	0 6	11 16	20 18	23 28
23	20 0	11 17	S. 17	11 37	20 30	23 27
24	19 48	10 57	0 40	11 58	20 42	23 26
25	19 35	10 36	1 4	12 19	20 54	23 24
26	19 21	10 15	1 27	12 40	21 5	23 22
27	19 8	9 54	1 51	13 0	21 16	23 19
28	18 54	9 33	2 14	13 20	21 27	23 16
29	18 40	9 12	2 38	13 40	21 37	23 13
30	18 25	8 50	3 1	14 0	21 46	23 9
31	18 10	8 28		14 19		23 4

The Declination of the Sun's Center when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomer's Day, for Jan., Febr., March, April, May, June 1774-

Days	Jan.	Feb.	Mar.	April	May	June
	South	South	South	North	North	North
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	22 59	16 59	7 26	4 41	15 11	22 7
2	22 54	16 42	7 3	5 4	15 29	22 14
3	22 48	16 24	6 40	5 27	15 46	22 22
4	22 42	16 6	6 17	5 50	16 4	22 29
5	22 35	15 48	5 54	6 12	16 21	22 36
6	22 28	15 30	5 31	6 35	16 38	22 42
7	22 20	15 11	5 8	6 58	16 54	22 48
8	22 12	14 52	4 44	7 20	17 11	22 53
9	22 4	14 33	4 21	7 42	17 27	22 59
10	21 55	14 13	3 57	8 5	17 42	23 3
11	21 45	13 53	3 34	8 27	17 58	23 8
12	21 35	13 33	3 10	8 48	18 13	23 11
13	21 25	13 13	2 46	9 10	18 28	23 15
14	21 15	12 53	2 23	9 32	18 43	23 18
15	21 4	12 32	1 59	9 53	18 57	23 21
16	20 52	12 11	1 35	10 15	19 11	23 23
17	20 40	11 50	1 12	10 36	19 24	23 25
18	20 28	11 29	0 48	10 57	19 38	23 26
19	20 15	11 8	0 24	11 17	19 50	23 27
20	20 2	10 46	0 1	11 38	20 3	23 28
21	19 49	10 25	N. 23	11 58	20 15	23 28
22	19 35	10 3	0 47	12 19	20 27	23 28
23	19 21	9 41	1 10	12 39	20 39	23 27
24	19 7	9 19	1 34	12 58	20 50	23 26
25	18 52	8 56	1 57	13 18	21 1	23 25
26	18 37	8 34	2 21	13 37	21 11	23 23
27	18 21	8 12	2 44	13 56	21 21	23 20
28	18 6	7 49	3 8	14 15	21 31	23 18
29	17 49		3 31	14 34	21 41	23 15
30	17 33		3 54	14 52	21 50	23 11
31	17 16		4 18		21 58	

The Declination of the Sun's Center, when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomers Day. for July, August, Sept. Oct. Nov. Dec. 1774.

Days	July	Aug.	Sept.	Oct.	Nov.	Dec.
	North	North	North	South	South	South
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 7	17 59	8 12	3 19	14 34	21 53
2	23 3	17 44	7 50	3 42	14 53	22 2
3	22 58	17 28	7 28	4 5	15 12	22 11
4	22 53	17 12	7 6	4 28	15 30	22 19
5	22 48	16 56	6 43	4 52	15 49	22 27
6	22 42	16 39	6 21	5 15	16 7	22 34
7	22 35	16 23	5 58	5 38	16 24	22 41
8	22 29	16 6	5 36	6 1	16 42	22 47
9	22 21	15 48	5 13	6 24	16 59	22 53
10	22 14	15 31	4 50	6 46	17 16	22 59
11	22 6	15 13	4 27	7 9	17 33	23 4
12	21 58	14 55	4 5	7 32	17 49	23 8
13	21 49	14 37	3 42	7 54	18 5	23 12
14	21 40	14 18	3 18	8 17	18 21	23 16
15	21 31	14 0	2 55	8 39	18 36	23 19
16	21 21	13 41	2 32	9 1	18 51	23 22
17	21 11	13 21	2 9	9 23	19 6	23 24
18	21 1	13 2	1 46	9 45	19 20	23 26
19	20 50	12 43	1 22	10 7	19 34	23 27
20	20 39	12 23	0 59	10 28	19 48	23 28
21	20 27	12 3	0 36	10 50	20 1	23 28
22	20 15	11 43	0 12	11 11	20 14	23 28
23	20 3	11 22	S. 11	11 32	20 27	23 27
24	19 51	11 2	0 35	11 53	20 39	23 26
25	19 38	10 41	0 58	12 14	20 51	23 25
26	19 25	10 20	1 22	12 35	21 2	23 23
27	19 11	9 59	1 45	12 55	21 13	23 20
28	18 57	9 38	2 8	13 15	21 24	23 17
29	18 43	9 17	2 32	13 35	21 34	23 14
30	18 28	8 55	2 55	13 55	21 44	23 10
31	18 14	8 34		14 14		23 5

The Declination of the Sun's Center, when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomers Day, for Jan. Feb. March, April, May, June 1775.

Days	Jan.	Feb.	Mar.	April	May	June
	South	South	South	North	North	North
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 1	17 4	7 32	4 35	15 6	22 5
2	22 55	16 46	7 9	4 58	15 24	22 13
3	22 50	16 29	6 46	5 21	15 42	22 20
4	22 43	16 11	6 23	5 44	16 0	22 27
5	22 37	15 53	6 0	6 7	16 17	22 34
6	22 30	15 34	5 37	6 29	16 34	22 41
7	22 22	15 16	5 13	6 52	16 51	22 47
8	22 14	14 57	4 50	7 14	17 7	22 52
9	22 6	14 37	4 26	7 37	17 23	22 57
10	21 57	14 18	4 3	7 59	17 39	23 2
11	21 48	13 58	3 39	8 21	17 54	23 7
12	21 38	13 38	3 16	8 43	18 10	23 11
13	21 28	13 18	2 52	9 5	18 25	23 14
14	21 17	12 58	2 29	9 26	18 39	23 17
15	21 6	12 37	2 5	9 48	18 53	23 20
16	20 55	12 17	1 41	10 9	19 7	23 23
17	20 43	11 56	1 18	10 31	19 21	23 25
18	20 31	11 35	0 54	10 52	19 34	23 26
19	20 19	11 13	0 30	11 12	19 47	23 27
20	20 6	10 52	0 7	11 33	20 0	23 28
21	19 53	10 30	N. 17	11 54	20 12	23 28
22	19 39	10 8	0 41	12 14	20 24	23 28
23	19 25	9 46	1 4	12 34	20 36	23 27
24	19 11	9 24	1 28	12 54	20 47	23 27
25	18 56	9 2	1 52	13 13	20 58	23 25
26	18 41	8 40	2 15	13 33	21 9	23 23
27	18 25	8 17	2 39	13 52	21 19	23 21
28	18 10	7 54	3 2	14 11	21 29	23 19
29	17 54		3 25	14 30	21 38	23 16
30	17 37		3 49	14 48	21 48	23 12
31	17 21		4 12		21 56	

(17)

The Declination of the Sun's Center, when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomers Day, for July, August, Sept. Oct. Nov. Dec. 1775.

Days	July	Aug.	Sept.	Oct.	Nov.	Dec.
	North	North	North	South	South	South
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 8	18 3	8 17	3 13	14 29	21 51
2	23 4	17 47	7 55	3 36	14 48	22 0
3	22 59	17 32	7 33	4 0	15 7	22 9
4	22 54	17 16	7 11	4 23	15 26	22 17
5	22 49	17 0	6 49	4 46	15 44	22 25
6	22 43	16 43	6 26	5 9	16 2	22 32
7	22 37	16 27	6 4	5 32	16 20	22 39
8	22 30	16 10	5 41	5 55	16 38	22 46
9	22 23	15 53	5 19	6 18	16 55	22 52
10	22 16	15 35	4 56	6 41	17 12	22 57
11	22 8	15 17	4 33	7 4	17 29	23 2
12	22 0	14 59	4 10	7 26	17 45	23 7
13	21 52	14 41	3 47	7 49	18 1	23 11
14	21 43	14 23	3 24	8 11	18 17	23 15
15	21 33	14 4	3 1	8 34	18 33	23 18
16	21 24	13 45	2 38	8 56	18 48	23 21
17	21 14	13 26	2 15	9 18	19 3	23 23
18	21 3	13 7	1 51	9 40	19 17	23 25
19	20 53	12 47	1 28	10 2	19 31	23 27
20	20 42	12 28	1 5	10 23	19 45	23 28
21	20 30	12 8	0 41	10 45	19 58	23 28
22	20 18	11 48	0 18	11 6	20 11	23 28
23	20 6	11 27	S. 5	11 27	20 24	23 27
24	19 54	11 7	0 29	11 48	20 36	23 26
25	19 41	10 46	0 52	12 9	20 48	23 25
26	19 28	10 25	1 16	12 30	21 0	23 23
27	19 15	10 4	1 39	12 50	21 11	23 21
28	19 1	9 43	2 3	13 10	21 22	23 18
29	18 47	9 22	2 26	13 30	21 32	23 15
30	18 32	9 0	2 49	13 50	21 42	23 11
31	18 18	8 39		14 10		23 7

The Declination of the Sun's Center when the Center is on the Meridian of London at the End of the Sea-Day, which is the Beginning of the Astronomer's Day, for Jan., Febr., March, April, May, June 1776.

D.	Jan.	Feb.	Mar.	April	May	June
	South	South	South	North	North	North
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
1	23 2	17 8	7 14	4 53	15 20	22 11
2	22 57	16 50	6 51	5 16	15 38	22 18
3	22 51	16 33	6 28	5 39	15 55	22 26
4	22 45	16 15	6 5	6 1	16 13	22 33
5	22 39	15 57	5 42	6 24	16 30	22 39
6	22 32	15 39	5 19	6 47	16 46	22 45
7	22 24	15 20	4 55	7 9	17 3	22 51
8	22 16	15 1	4 32	7 31	17 19	22 56
9	22 8	14 42	4 9	7 54	17 35	23 1
10	21 59	14 23	3 45	8 16	17 51	23 6
11	21 50	14 3	3 22	8 38	18 6	23 10
12	21 40	13 43	2 58	9 0	18 21	23 13
13	21 30	13 23	2 34	9 21	18 36	23 17
14	21 20	13 3	2 11	9 43	18 50	23 20
15	21 9	12 42	1 47	10 4	19 4	23 22
16	20 58	12 22	1 23	10 25	19 18	23 24
17	20 46	12 1	1 0	10 46	19 31	23 26
18	20 34	11 40	0 36	11 7	19 44	23 27
19	20 22	11 18	0 12	11 28	19 57	23 28
20	20 9	10 57	N. 11	11 49	20 9	23 28
21	19 56	10 35	0 35	12 9	20 22	23 28
22	19 42	10 14	0 59	12 29	20 33	23 28
23	19 28	9 52	1 22	12 49	20 45	23 27
24	19 14	9 30	1 46	13 9	20 56	23 26
25	18 59	9 7	2 9	13 28	21 6	23 24
26	18 44	8 45	2 33	13 47	21 17	23 22
27	18 29	8 23	2 56	14 6	21 27	23 19
28	18 13	8 0	3 20	14 25	21 36	23 16
29	17 57	7 37	3 43	14 44	21 45	23 13
30	17 41		4 6	15 2	21 54	23 9
31	17 25		4 29		22 3	

Declination of the Sun's Center, when the Center is on the Meridi-
 London at the End of the Sea Day, which is the Beginning of
 Astronomer's Day, for July, August, Sept. Oct. Nov. Dec. 1776.

July	Aug.	Sept.	Oct.	Nov.	Dec.
North	North	North	South	South	South
D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
23 5	17 51	8 1	3 31	14 44	21 58
23 11	17 36	7 39	3 54	15 3	22 7
22 56	17 20	7 16	4 17	15 21	22 15
22 50	17 4	6 54	4 40	15 40	22 23
22 45	16 47	6 32	5 3	15 58	22 31
22 38	16 31	6 9	5 26	16 16	22 38
22 32	16 14	5 47	5 49	16 32	22 44
22 25	15 57	5 24	6 12	16 51	22 50
22 18	15 39	5 2	6 35	17 8	22 56
22 10	15 22	4 39	6 58	17 25	23 1
22 2	15 4	4 16	7 21	17 41	23 6
21 54	14 46	3 53	7 43	17 57	23 10
21 45	14 27	3 30	8 6	18 13	23 14
21 36	14 9	3 7	8 28	18 29	23 18
21 26	13 50	2 44	8 50	18 44	23 20
21 16	13 31	2 20	9 12	18 59	23 23
21 6	13 12	1 57	9 34	19 14	23 25
20 55	13 52	1 34	9 56	19 28	23 26
20 44	12 33	1 10	10 18	19 42	23 27
20 33	12 13	0 47	10 39	19 55	23 28
20 21	11 53	0 24	11 1	20 8	23 28
20 9	11 32	0 0	11 22	20 21	23 28
19 57	11 12	S. 23	11 42	20 33	23 27
19 44	10 51	0 47	12 4	20 45	23 26
19 31	10 30	1 10	12 25	20 57	23 24
19 18	10 9	1 34	12 45	21 8	23 21
19 4	9 48	1 57	13 5	21 19	23 19
18 50	9 27	2 21	13 25	21 30	23 16
18 36	9 6	2 44	13 45	21 39	23 12
18 21	8 44	3 7	14 5	21 49	23 8
18 6	8 22		14 24		23 3

To take out the Sun's Declination.

The common Day begins at Twelve at Night. The Sea-day begins at the Noon before, or twelve Hours looner than the common Day. The Astronomers begin their Day at Noon; but 12 Hours after the common Day, and 24 Hours after the Sea-Day; so that when the Sea-Day ends the Astronomer's Day begins.

The Sun's Declination, in the Tables, is computed for Noon or the Beginning of the Astronomers Day which is called by the same Day of the Month as is the End of the present Sea-Day; for this Reason, when you take out the Declination at Noon you use the same Day of the Month as is the Date of the Sea-Day.

E X A M P L E.

What is the Sun's Declination January the 2d, 1773, at Noon or End of the Sea-Day?

[This is the Beginning of January 2d with the Astronomers.] Look in the Table that has 1773 at the Top of it, and right against the 2d Day of the Month under January is 22 Degrees 52 Minutes Declination South, according to the Title at the Top of the Table.

But should you want the Declination for any Time after the Noon of the Sea-Day, you know you must reckon one Day less than the Date of the new Sea-Day.

E X A M P L E.

Suppose you want the Sun's Declination for Sunday January the 3d, 1773, at One P. M.

This Time is called by the Astronomers Saturday January the 2d, 1773, one Hour.

(For a Method of finding the Declination at any Hour of the Day, see Page 19.)

Note, P. M. stand for these Latin Words *Post Meridiam*, meaning after Middle Day, or when the Sun has passed the Meridian. A. M. stand for *Ante Meridiam*, meaning before the Sun is upon the Meridian.

From the 20th or 21st of March to the 21st or 22d of June the Sun increases his Declination, and decreases it from the 21st or 22d of June till the 22d of September; and all this Time, that is, from the 20th or 21st of March to the 22d of September his Declination

Declination is North. From the 22d of September the Declination increases till the 21st or 22d of December, and then it decreases till the 20th or 21st of March; all this Time, that is, from the 22d of September to the 20th or 21st of March, the Declination is South.

To find the Sun's Daily Alteration of Declination, that is, how many Miles he alters his Declination between one Noon and the following Noon.

R U L E.

Look out the Declination for the given Day of the Month and for the Day following the given Day, and if the Declinations are both North or both South, subtract the Lesser from the Greater, the Remainder is the Daily Alteration; but if one Declination be North, and the other Declination South, add the Declinations together, and the Sum is the Daily Alteration of Declination.

E X A M P L E.

How many Miles does the Sun alter his Declination between the Noons of January the 1st, 1773, and January the 2d, 1773?

	D. M.
Sun's Declination January the 1st, 1773,	22 58 South
Sun's Declination January the 2d, 1773,	22 52 South

The Declinations being both of one Name (South) }
 subtract and there remains the Daily Alteration } 0 6 Miles
 for these 24 Hours,

E X A M P L E II.

How many Miles will the Sun alter his Declination between March the 19th, 1773, and March the 20th, 1773?

Declination March 19,	19 South
Declination March 20,	5 North

These Declinations being of a contrary Name (that is, one North and the other South) add, and the Sum is the Daily Alteration of Declination, } 24 Miles

A TABLE

A TABLE of the Alteration of the Sun's Declination to every Degrees of Longitude, from the Meridian of *London*.

Daily Alteration of the Sun's Declination.	DEGREES OF LONGITUDE.																
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
	Miles of Alteration in the Declination belonging to each Ten Degrees of Longitude.																
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

The Use of this TABLE of Degrees of Longitude.

The Sun's Declination being computed for the Meridian of *London*, those Tables will not fit any other Meridian; because, as the Sun is continually moving forward in the *Ecliptic*, he is continually altering his Declination: therefore, if your Longitude in should be 10 Degrees East or West when the daily Alteration of Declination is 24 Miles, the Declination at the Ship's Meridian will differ one Mile from the declination in the Tables; and the

bigger

bigger your Longitude in is, the more will the Declination at the Ship's Meridian differ from the declination in the Tables.

This Table of Degrees of Longitude shews how many Miles the Declination alters according to the daily Alteration of declination and the Longitude in.

To use the Number of Miles taken from this Table, that you may get the Sun's true declination at the Ship's Meridian.

R U L E

First, Find the daily Alteration of declination--- Then observe whether the declination be increasing or decreasing, this you may know directly thus: If the declination for the given day be lesser than the declination for the Day following, the declination is increasing; but, if the declination for the given day be bigger than the Declination for the following day, then the declination is decreasing. But when the Sun crosses the Equinoctial and so changes his declination from North to South, or from South to North, then, you know, the declination has decreased and also increased between the two Noons.

Secondly, Look for the daily Alteration of declination in the first Row of the Table above, and carry your Finger strait along 'till it is under the degree of Longitude nearest to your Longitude in; take out that Number of Miles and put it under the declination taken from the Tables; and, to know whether you are to add this Number of Miles to the declination or subtract it from the declination this is the Rule.

LONGITUDE in *East* and the Declination *Increasing*.

Add the Miles to the Declination.

The declination *decreasing*, Add the Miles to the declination.

Then you will have the Sun's true declination for the Longitude in, on the day required.

LONGITUDE in *West* and the Declination *Increasing*.

Subtract the Miles from the declination.

The Declination *decreasing*, Subtract the Miles from the Declination.

E X A M P L E

Suppose, on September 10th, 1773, a Ship in the Longitude of 64 degrees, West, what will be the Sun's true Declination when the Sun is on the Ship's Meridian?

D. M.

Declination at London, September 10th, 1773, is 4 45 North

Declination at London, September 11th, is 4 22 North

The daily Alteration of Declination is 23 Miles

And because the Declination on the 10th Day is bigger than the Declination on the 11th day, the Declination is decreasing.

The

D. M.

The Sun's Declination *September 10th*,
I find the daily Alteration of Declination 23 Miles
in the first Row at the Left Hand in the Table of
Longitude, and carry my Finger along till it comes
under 60 degrees (because 64 degrees, the Ship's
Longitude in, is nearer 60 degrees than 70 de-
grees) and there are 4 Miles, these 4 Miles I put
under the declination at *London*, on *September 10th*,

4 45

4

Because the Longitude in is West and the decli-
nation is decreasing, Subtract, as the Rule above
directs, and there will remain the Sun's true decli-
nation required, at Noon, at the Ship,

4 41 North

EXAMPLE II.

Suppose the Longitude in be 73 Degrees East on March the 20th,
1773, what is the Sun's true Declination when he is on the Ship's
Meridian or Noon?

You will find the daily Alteration of Declination is 24 Miles,
and the declination increasing. The daily Alteration 24 Miles,
and 73 degrees, or 70 degrees of Longitude, gives by Table of
Longitude, 5 Miles--- Then,

For the Declination at the Ship.

D. M.

The Sun's Declination at *London*, *March 20th*,
Alteration of Declination for 73 Degrees of
Longitude, - - - - -

0 5 North

5

Subtract, because the Longitude in is *East*, and
the Declination is increasing, and there remains
the Sun's true Declination, required at Noon,
at the Ship's Meridian.

0 0

The Declination being nothing, the S n is upon the Equinoctial
at the Ship's Meridian.

EXAMPLE II.

September 22, 1773, Longitude in 71 Degrees West, what is the
Declination, at Noon, at the Ship?

Answer.--- The Sun's Declination, one Mile and a Half
North.

How to work an Observation by the SUN, to find the Latitude *in*.

Finding the true Latitude of the Ship is, at all Times, very agreeable to the Navigator, and he well knows it to be a thing of the greatest Use, when he is going to make his Port, even after a short Voyage; therefore, the Plainness and easiness of the following Rules will, it is hoped, make full Amends for the Length of them.

The Latitude, is, the Number of the Degrees and Minutes of that Part of the Arch of the Meridian, which lies between the Ship, or any Place, and the Equator.--- This Arch measures exactly the same Number of Degrees and Minutes as that Arch, in the Heaven, which lies between the direct distance from the Zenith to the Equinoctial. Therefore, by knowing the Distance from the Zenith to the Sun, and also the Sun's Distance from the Equinoctial; that is, the Sun's Declination, the Distance from the Zenith to the Equinoctial is easily found; and when this Distance is found, the Latitude of the Ship, or of any Place, is then found.

Note 1. When you have found the true Meridian Altitude of the Sun's Center, (as mentioned in Page 20 and 25 of the Directions for using Hadley's Quadrant) subtract this Altitude from 90 Degrees, what remains, is the Distance from the Zenith to the Sun's Center; this Distance you call *North*, if the Sun was on the North Side of your Zenith when you observed; but if the Sun was on the South Side, you are to call the Zenith Distance *South*.

2. Take out the Sun's Declination, and mark it North or South as it is called in the Tables. The Sun is said to have North Declination when he is on the North Side of the Equinoctial, and South Declination when he is on the South Side of the Equinoctial.

To find the Latitude *in*.

RULE I.

When the Zenith Distance and the Declination have a different Name, that is, when the Zenith Distance is North and the Declination is South, or when the Zenith Distance is South, and the Declination is North,

Add

Add the Zenith Distance and the declination together, the Sum is the Latitude in; and the Latitude will be of the same Name as the declination; that is, if the declination be North, the Latitude will be North; if the declination be South, the Latitude will be South.

R U L E II.

When the Zenith distance and the declination have the same Name; that is, when they are both North or both South,

Subtract the Lesser from the Greater, what remains is the Latitude in; and to know whether the Latitude be North or South, this is the Rule;

If the declination be bigger than the Zenith distance, call the Latitude by the same Name the declination is called: But, if the declination be lesser than the Zenith distance, the Latitude is of the contrary Name to the declination.

Note 1. When the Sun's declination is nothing, the Zenith distance is the Latitude in, and the Latitude is of a contrary Name to the Zenith distance,

2. When the Zenith distance is nothing (that is, when the Sun's Center is on the Zenith), the declination is the Latitude in, and the Latitude is of the same Name as the declination.

R U L E III.

For those Latitudes where the Sun does not set for many Days.

This happens in the Greenland Seas, and other Parts of the Earth beyond the Latitudes of 67 Degrees North and 67 Degrees South.

In these Latitudes the Sun's Meridian Altitude may be observed twice in about twenty-four Hours; the Sun appearing once upon the Meridian above the Pole which is his greatest Altitude, and, about twelve Hours afterwards, he is seen again upon the Meridian below the Pole, which is his least Altitude.

C A S E I.

When you observe the greatest Meridian Altitude, that is, when the Sun is on the Meridian above the Pole,

If the Zenith Distance and the Declination have a different Name, use Rule the First; but, if they have the same Name, use Rule the Second.

C A S E II.

When you are to observe the least Meridian Altitude, or when the Sun is on the Meridian below the Pole, this is the Rule:

Find

1. Find the Declination at London at Twelve at Night, and then correct it for the Longitude of the Ship; thus:— Take out the Declination at the last Noon and at the next Noon, subtract the lesser from the greater, and get the daily Alteration; find the Half of this daily Alteration, and add it to the Declination at the last Noon, if the Declination is increasing: But subtract the half of the daily Alteration from the last Noon's Declination, if the Declination is decreasing, then you will have the Sun's true Declination at Midnight at London: This Declination you must then alter, according to the Longitude of your Ship.

To find the Height of the Pole above the Horizon, which is proved to be exactly as many Degrees and Minutes as is the Distance between the Equinoctial and the Zenith.

Subtract the Declination (found as just now directed) from 90 Degrees; what remains add to the true Meridian Altitude of the Sun's Center. This Sum gives you the Latitude in, and it is always of the same Name as the declination.

Before any Examples are given, I beg leave to mention, that the higher the Observer's Eye is above the Water, the more Altitude he will have upon his Quadrant (see Chap. iv. page 26, of the directions for using Hadley's Quadrant); therefore, an Observer upon the Quarter-deck ought to have more Altitude than an Observer upon the Main-deck; if both Quadrants be good and in proper Order, and themselves of an equal Tallness.

EXAMPLE I.

January 21st, 1773, 40 Degrees West of London, the Meridian Altitude of the Sun's lower Edge was observed 74 Degrees, 19 Minutes from the North Point of the Horizon, the Eye being 25 Feet above the Sea; what Latitude was the Ship in?

The Sun's declination at the Ship's Meridian is 19 degrees, 44½ or 45 Minutes South, found by the daily Alteration of declination and the Ship's Longitude.

The true Meridian Altitude of the Sun's Center (found as in Page 21 of the directions for using Hadley's Quadrant) is 74 degrees, 30 Minutes. Now, for the Latitude in,

	D. M.
The distance from the Zenith to the Horizon is	90 0
Subtract the true Merid. Altitude of Sun's Center	74 30
Remains the true Meridian distance of the Sun's Center from the Zenith, called the Meridian Zenith distance	15 30 North

E

And

And it is to be named North, because the Sun was on the North Side of the Zenith when he was upon the Meridian.

To know which of the two Rules you must use, remember this short Rule--- Zenith distance and declination of a different Name add them, as by Rule First; when the same of the same Name subtract the Lesser from the Greater, as by Rule Second.

In this Example they are of a different Name, you see the declination is South and the Zenith distance is North, therefore, use Rule First, add.

To the Sun's declination	-	-	-	-	-	D.M.	19 45 South
Add the Zenith distance	-	-	-	-	-	15 30 North	

The Sum is the Latitude in - - - - 35 15 South

Rule First says, when you add the Latitude is of the same Name as the declination, therefore the Latitude in is South.

Having put down, so plainly, the Work of one Example, the Mariner can easily work out the following Questions, therefore I shall give only the full Answers that he may be sure he is right.

EXAMPLE II.

July 17th, 1773, Longitude in 7 Degrees 50 Minutes East, Meridian Altitude of the Sun's lower Edge, 69 Degrees 39 Minutes South, Height of the Eye 8 Feet, what is the Latitude in?

Answer,--- The Longitude in being less than 10 degrees, the declination is the same at the Ship as in the Tables, 21 deg. 9 Minutes North.--- Meridian Altitude of Sun's Center 69 degrees 52 Minutes South.--- Zenith distance 20 degrees 8 Minutes South.--- Zenith distance and declination being of different Names, use Rule First, Latitude in 41 degrees 17 Minutes North.

EXAMPLE III.

June 28th, 1773, Longitude in 82 Degrees West, Meridian Altitude of the Sun's lower Edge 79 Degrees 8 Minutes North, Height of the Eye 22 Feet, what is the Latitude in?

Answer---Declination at the Ship 23 degrees 16 Minutes North, Zenith distance 10 Degrees 40 Minutes North,---declination and Zenith distance being both of one Name, use Rule Second, Latitude in 12 degrees 36 Minutes, and the Latitude is North, because the zenith distance is less than the declination.

EXAMPLE IV.

May 25th, 1773, Longitude in 27 Degrees West, Meridian Altitude of the Sun's lower Edge 53 Degrees 45 Minutes North, Height of the Eye 27 Feet, what is the Latitude in?

Answer

Answer, declination at the Ship 21 degrees 5 Minutes North, zenith distance 36 degrees 5 Minutes North, Latitude in 15 degrees 0 Minutes South, because the declination is less than the Zenith distance.

EXAMPLE V.

September 23d, 1775, If a Ship is in the Longitude of 70 Degrees East, and observes Meridian Altitude of the Sun's lower Edge 79 Degrees 16 Minutes South, Height of the Eye 10 Feet, what is the Latitude in?

Answer,--- declination at the Ship 0 degrees, 0 Minutes, zenith distance 10 degrees 31 Minutes South--- The declination being nothing, the Sun is on the Equinoctial, therefore, by Note First under Rule Second the zenith distance is the Latitude in, and the Latitude is North because the Latitude is of a different Name to the zenith distance.

EXAMPLE VI.

May 20th, 1773, Longitude in 45 degrees West, Meridian Altitude of the Sun's lower Edge 89 Degrees 49 Minutes North, Height of the Eye 24 Feet, what is the Latitude in?

Answer,--- declination at the Ship 20 degrees $7\frac{1}{2}$ or 8 Minutes North, zenith distance 90 degrees, that is, Nothing, therefore, the Sun's Center is in the zenith, and by Note 2. of Rule Second the declination is the Latitude in 20 degrees 8 Minutes, and the Latitude is North of the same Name as the declination.

EXAMPLE VII. by RULE III.

May 30, 1773, Longitude in 19 Degrees East, Meridian Altitude of the Sun's lower Edge, observed under the Pole 7 Degrees, 17 Minutes North, Height of the Eye 10 Feet; what is the Latitude in?

Answer,--- As the Sun does not set, work by Rule III. and as the least Meridian Altitude (or when the Sun is under Pole) was observed; use Case II.

The daily alteration of declination between May 29 (the last Noon) and May 30 is 9 Miles, the Half of it 4 Miles and a Half added to the declination at Noon, May 29, (because the declination is increasing) gives 21 degrees 46 Miles for the declination at London at 12 at Midnight--- The daily Alteration of declination 9 Miles and 19 degrees of Longitude, by Table Page 12 gives Half a Mile Alteration of declination, therefore the declination at the Ship at the Time of Observation is 21 degrees 47 Miles North. Subtracting the declination from 90 degrees there remains 68 degrees 13 Minutes, the Complement of the declination.

T.

D. M.

To the Complement of the declination	68	13
Add the true Meridian Altitude of Sun's Center	7	17
The Sum is the Arch of the Meridian contained between the Pole and the Horizon, or, as it is commonly called, the Height of the Pole above the Horizon, which is the Latitude in	75	30

The Latitude is North because the Declination is North.

Of finding the Latitude of the Ship by the Meridian Altitude of a bright Star.

A good Observation of the Sun, when the Navigator judges himself about making the Land, gives him great Pleasure, especially if he has had no Observation two or three days before.---By the Help of the Observation he mends his dead reckoning, and fo shapes a safe Course to his Port, thereby shunning the dangers of Rocks, Sands, and, perhaps, a narrow Channel: All which dangers the want of a good Observation may, often, make him liable to.--- But it should be mentioned, that the Meridian Observation of the Sun may be often doubted; for should a Fog or a Squall arise, or a Cloud come up just about Noon, though it goes off almost directly, if the Navigator be not hindered from making the Observation, yet it may be so bad an Observation, that it ought not to be depended upon; for, unless you plainly see the Sun both rise and fall, or, before he has fallen, to rest a few Minutes (which is a Sign of his being upon the Meridian) you cannot be sure that your Observation is good.--- When a good Observation cannot be had by the Sun, the next easy Method of finding the Latitude of the Ship, is, by the Meridian Altitude of a bright Star, which may be taken with tolerable Exactness, if the Horizon under it be clear; and it is to be remembered, that a bright Star-light Night often follows a cloudy day.--- If it be said, *No Ship has suffered by not using a Star to find her Latitude in,** ---[See the Article of Intelligence at the Bottom of this Page]--- I answer, *Ships*

*** THE GENERAL EVENING POST (London.)**

From Tuesday, Nov. 20, to Thursday, Nov. 22, 1764, (No. 4851.)

Admiralty-Office, Nov. 19. Information has been sent to this Office, that the Ship *Bowlab*, of the Burthen of about 200 Tons, whereof *John Green* was Master, bound from *New-York* to *London*, chiefly laden with Mahogany and Fustick, did, about the 10th Instant, for want of being able to make proper Observations, proceed into *Bristol Channel*, and was lost in the Night between the 12th and 13th Instant, on the Sands called *Saunton Sands*, near *Braunton*, in the County of *Devon*; when the Master, with most of the Crew, and three Passengers, perished.

Ships have been saved by finding their Latitude by the Meridian Altitude of a Star; one, particularly, without Massé, driven into St. George's Channel, and not having had an Observation some Days, she knew not where she was, till after finding the Latitude by the Meridian Altitude of a Star, and then she got safe into Milford— Finding the Time of a Star's coming upon the Meridian, without more Help, is of little or no Use to a Navigator, who knows not that Star when he sees it; therefore, with the Rule for finding the Time of a Star's coming upon the Meridian here is a List of some of the principal fixed Stars, shewing both the Time each Star comes upon the Meridian, and its true Meridian Altitude in certain Latitudes; by which Helps and the Rule mentioned in the Use of the List of Stars, the Navigator will be able readily to find out and be so well acquainted with each Star, as quickly to know the Star again in Time of Need.



A TABLE

NOTE. The Time being marked in the beginning of the Column, and the Latitude in the end of the Column, the Navigator may find the Time of a Star's coming upon the Meridian, and its true Meridian Altitude in certain Latitudes.

A TABLE of the Sun's Right Ascension for each Noon, or the Beginning of the Astronomer's Day, which is the End of the Sea-Day; fitted to the Months of *January, February, March, April, May, and June 1772.*

As the Sun does not alter his Right Ascension more than about three Minutes and a Half in 100 Years, this Table will serve many Years with Exactness.

Day	Jan.	Feb.	Mar.	April	May	June
	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	18 51	21 3	22 52	0 45	2 37	4 39
2	18 56	21 7	22 56	0 49	2 40	4 44
3	19	21 11	22 59	0 53	2 44	4 48
4	19 4	21 15	23 3	0 56	2 48	4 52
5	19 9	21 19	23 7	1 0	2 52	4 56
6	19 13	21 23	23 10	1 3	2 56	5
7	19 17	21 27	23 14	1 7	3 0	5 4
8	19 22	21 31	23 18	1 11	3 4	5 8
9	19 26	21 35	23 21	1 14	3 7	5 12
10	19 31	21 39	23 25	1 18	3 11	5 17
11	19 35	21 43	23 29	1 22	3 15	5 21
12	19 39	21 47	23 32	1 25	3 19	5 25
13	19 44	21 51	23 36	1 29	3 23	5 29
14	19 48	21 55	23 40	1 33	3 27	5 33
15	19 52	21 59	23 43	1 37	3 31	5 37
16	19 56	22 3	23 47	1 40	3 35	5 41
17	20 1	22 6	23 51	1 44	3 39	5 46
18	20 5	22 10	23 54	1 48	3 43	5 50
19	20 9	22 14	23 58	1 51	3 47	5 54
20	20 13	22 18	0 2	1 55	3 51	5 58
21	20 18	22 22	0 5	1 59	3 55	6 2
22	20 22	22 25	0 9	2 3	3 59	6 6
23	20 26	22 29	0 13	2 6	4 3	6 11
24	20 30	22 33	0 16	2 10	4 7	6 15
25	20 34	22 37	0 20	2 14	4 11	6 19
26	20 38	22 41	0 23	2 18	4 15	6 23
27	20 43	22 44	0 27	2 21	4 19	6 27
28	20 47	22 48	0 31	2 25	4 23	6 31
29	20 51		0 34	2 29	4 27	6 35
30	20 55		0 37	2 33	4 31	6 40
31	20 59		0 42		4 35	

NOTE, The Table being made for the Beginning of the Astronomers Day, always take out for one Day sooner than the Date of the Sea-Day.

A TABLE

A TABLE of the SUN's Right Ascension for each Noon, or the Beginning of the Astronomers Day, which is the End of the Sea-Day; fitted to the Months of *July, August, September, October, November, and December 1772.*

Days	July	Aug.	Sept.	Oct.	Nov.	Dec.
H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.
1	6 44	8 48	10 44	12 32	14 29	16 33
2	6 48	8 52	10 48	12 36	14 33	16 38
3	6 52	8 56	10 52	12 40	14 37	16 42
4	6 56	9 0	10 55	12 43	14 41	16 46
5	7	9 4	10 59	12 47	14 45	16 51
6	7 4	9 8	11 2	12 51	14 49	16 55
7	7 8	9 11	11 5	12 54	14 53	16 59
8	7 13	9 15	11 10	12 58	14 57	17 4
9	7 17	9 19	11 13	13 2	15 1	17 8
10	7 21	9 23	11 17	13 5	15 5	17 13
11	7 25	9 27	11 20	13 9	15 9	17 17
12	7 29	9 30	11 24	13 13	15 13	17 21
13	7 33	9 34	11 28	13 16	15 17	17 26
14	7 37	9 38	11 31	13 20	15 21	17 30
15	7 41	9 42	11 35	13 24	15 25	17 35
16	7 45	9 45	11 38	13 28	15 30	17 39
17	7 49	9 49	11 42	13 31	15 34	17 43
18	7 53	9 53	11 45	13 35	15 38	17 48
19	7 57	9 57	11 49	13 39	15 42	17 52
20	8 1	10 0	11 53	13 43	15 46	17 57
21	8 5	10 4	11 56	13 46	15 50	18 1
22	8 9	10 8	12 0	13 50	15 55	18 6
23	8 13	10 11	12 3	13 54	15 59	18 10
24	8 17	10 15	12 7	13 58	16 3	18 15
25	8 21	10 19	12 11	14 2	16 7	18 19
26	8 25	10 22	12 14	14 6	16 12	18 24
27	8 29	10 26	12 18	14 9	16 16	18 28
28	8 33	10 30	12 22	14 13	16 20	18 32
29	8 37	10 33	12 25	14 17	16 25	18 37
30	8 41	10 37	12 29	14 21	16 29	18 41
31	8 44	10 41	—	14 25	—	18 46

To find the apparent Time (or Time by the Sun) of a Star's being upon the Ship's Meridian, upon any given Day.*

R U L E.

Take out the Sun's Right Ascension for one Day sooner than the Date of the Sea-Day, and subtract the Sun's Right Ascension from the Star's Right Ascension, the Remainder is the Time past Noon of the Star's coming upon the Meridian; but if the Sun's Right Ascension be bigger than the Star's, add 24 Hours to the Star's Right Ascension, then subtract and you will have the Time you seek for.

Note, This Rule will never differ more than 6 Minutes from the exact Time whatever Longitude the Ship be in, therefore it is near enough, as the Observer, generally, allows better than a Quarter of an Hour to make the Meridian Observation.

The Stars come on the Meridian about 4 Minutes sooner than they did the Night before.

E X A M P L E.

What Time will ALDEBARAN be on the Meridian January the 1st, Sea-Day, 1773?

By the Rule, take out for one Day sooner than the Sea-Day, this carries it back to *December 31st.*

The Star's Right Ascension in Page is 4 Hours, 23 Minutes.

The Sun's Right Ascension in Page 23 is 18 Hours, 46 Minutes.

The Sun's Right Ascension being bigger than the Star's, add 24 Hours to the Star's, then Subtract--- thus :

	H. M.
Star's Right Ascension 4 H. 23 M. add 24 H. makes	28 23
Sun's Right Ascension - - - - -	18 46
Time the Star will be on the Meridian, after Noon or	9 37 P. M.

E X A M P L E.

What Time will Arcturus be on the Meridian, March 30th. Sea-Day?

Arcturus Right Ascension - - - - - 14 5

Sun's Right Ascension, March 29th, - - - - - 0 34

Time the Star will be on the Meridian after Noon 13 31
Subtract 12

That is, gives 31 Min. past 1 in the Morning, or 1 31 A. M.
The

* The Meridian spoken of means the True North and South Points of the Horizon, therefore the Variation of your Compass must be allowed for, thus,--- Suppose you steer S. by W. $\frac{1}{2}$ W. by a Compass that has one Point and a Half West Variation, the True Course will be South, because with West Variation you reckon from the Course steered against the Sun; but had your Compass varied one Point and a Half Easterly, you reckon with the Sun and the True Course would then be S. W. by S.

The Right Ascension and Declination of some of the biggest fixed Stars fitted to the Beginning of the Year 1773.

	Right Ascens.		Declination		Alteration of Declination every Year.	
	H. M.	D. M.			Add Seconds	Subtract Seconds.
<i>Aldebaran</i> , the South Eye of the Bull -	4 23	16 2 N			8	—
<i>Regulus</i> , the Lion's Heart - - - -	9 56	13 4 N			—	17
<i>Arcturus</i> , in Bootes - - - - -	14 5	20 23 N			—	17
<i>Lyra</i> , the Bright Star in the Harp - -	18 29	38 35 N			2	—
<i>Aquila</i> , the Eagle - - - - -	19 40	8 17 N			8½	—
<i>Fomalhaut</i> , in the Mouth of the South Fish	22 45	30 49 S			—	19

Note--- The Right Ascensions of these Stars increase so little in one Year, that at the End of Twenty Years they will not be one Minute and a Half bigger, therefore these Right Ascensions will serve very well for that or a longer Time, to answer the Design of knowing the near Time, at Sea, of a Star's coming upon the Meridian to observe its Meridian Altitude.

The Declination of the Stars ought, always, to be found exactly, which is done thus---

EXAMPLE I.

What will be the Declination of Aquila, January 1, 1786?

From the Year - - - - - 1786

Subtract the Year the List is made for - 1773

Remains - - - - - 13 Years.

Multiply by the Alteration of Declination }
every Year - - - - - 8½

104 Seconds

And 13 Half Seconds say - - - - - 6

* Gives the Alteration of Declination in 13 Years 110 Seconds.

To bring the Seconds to Minutes divide by 60) 60 (1 Min.

50 Seconds.

Gives

Gives 1 Minute 30 Seconds, Alteration of Declination in Years--- And because the $8\frac{1}{2}$ Seconds stand under the Word, Add for this Reason,

	<i>D. M.</i>
To the Declination in 1773 - - - - -	8 17 North
Add the Alteration in 13 Years, 1 Minute	} 0 2
50 Seconds, which, because the Seconds	
are above 30, call, 2 Minutes - - -	

Gives *Aquila's* Declination, Jan. 1, 1786 - 8 19 North

E X A M P L E . II.

What will be the Declination of Regulus, January 1, 1786?

From - - - - -	1786
Subtract the Year the List is made for -	1773
	13 Years
Multiply by the Alteration of Declination	} 17
every Year - - - - -	
	91
	13

Gives the Alteration of Declination in 13 Years 221 Seconds

Divide by - - - - - 60) 180 (3 Min.

41 Seconds

Gives 3 Minutes 41 Seconds Alteration of Declination in Years--- And because the 17 Seconds stand under the Word, Subtract, for this Reason,

	<i>D. M.</i>
From the Declination in 1773, - - - - -	13 4 North
Subtract the Alteration in 13-Years, 3 Minutes,	} 4
41 Seconds, which, because the Seconds are	
above 30, call 4 Minutes	

Gives *Regulus* Declination January 1st 1786 13 -- North

How to find a Star in the Heavens to observe its Meridian Altitude for finding the Latitude of the Ship.

First, To get the Star upon the Horizon Glass.

Secondly, To carry your Eye up to the Star in the Heaven,

Thirdly, To bring the Star down to the Horizon to observe its Meridian Altitude.

T

the system. The system is a

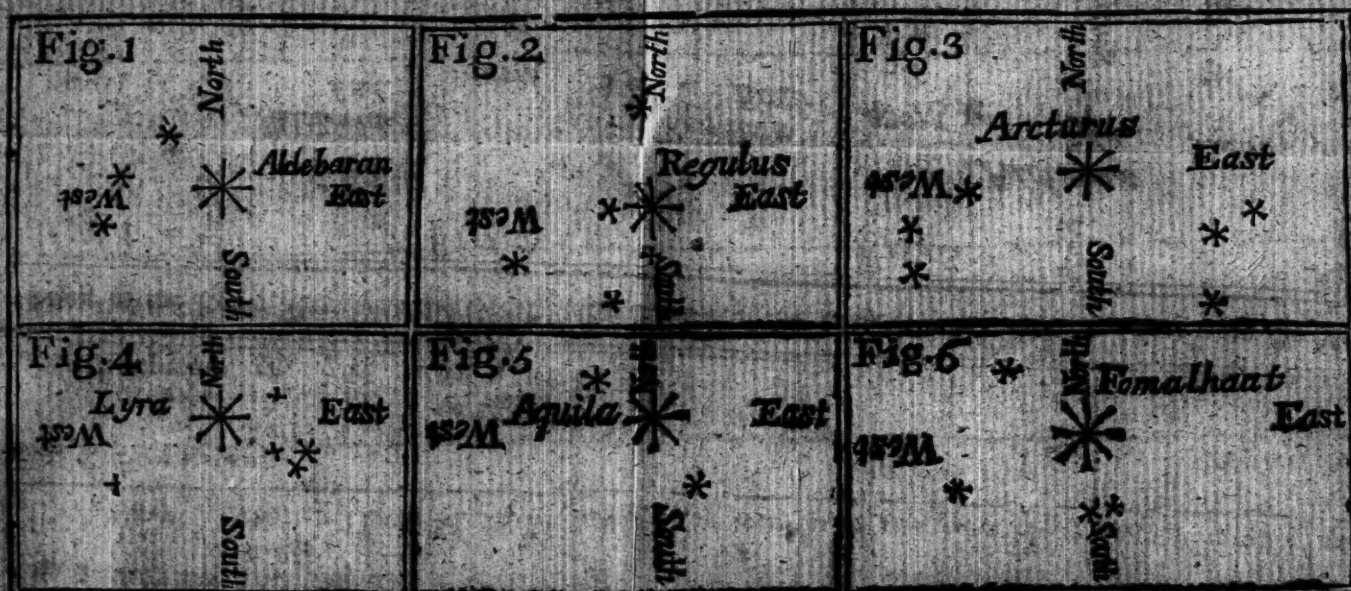
10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

Time of its publication

A TABLE shewing the Time, on the Sea-Day, of the Southing of some of the Biggest Stars, and also the true Meridian Altitude of each Star in the Latitudes above will be as mentioned. If the Weather allow it the Mariner may, every Night, use one of these Stars, by finding the Time of the Star's coming to the Meridian, and the true Meridian Altitude of the Star, by finding the Time of the Star's coming to the Meridian, steady Light, but all the fixed Stars twinkle.

The NAME of each STAR, AND The Time of its being on the Meridian upon the First Day of the Month.		D. 60	D. 59	D. 58	D. 57	D. 56	D. 55	D. 54	D. 53	D. 52	D. 51	D. 50	D. 49	D. 48
		The true Meridian Altitude of each Star in the Latitudes above will be as mentioned. 38 Degrees <i>Lyra's</i> Altitudes are counted from the North Point of the Horizon, 38 Degrees, and, also, All the Altitudes of the other Stars are counted from the same Point.												
Fig. 1. ALDEBERAN, a Red Star, <i>Souths</i>		D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
October	1st, 3 H. 54 M. A. M.	46, 2	47, 2	48, 2	49, 2	50, 2	51, 2	52, 2	53, 2	54, 2	55, 2	56, 2	57, 2	58, 2
November	1st, 1 H. 58 M. A. M.													
December	1st, 11 H. 54 M. P. M.													
January	1st, 9 H. 37 M. P. M.													
February	1st, 7 H. 24 M. P. M.													
Fig. 2. REGULUS, a Red Star, <i>Souths</i>														
March	1st, 11 H. 8 M. P. M.	43, 4	44, 4	45, 4	46, 4	47, 4	48, 4	49, 4	50, 4	51, 4	52, 4	53, 4	54, 4	55, 4
Fig. 3. ARCTURUS a Reddish Star, <i>Souths</i>														
April	1st, 1 H. 23 M. A. M.	50, 23	51, 23	52, 23	53, 23	54, 23	55, 23	56, 23	57, 23	58, 23	59, 23	60, 23	61, 23	62, 23
Fig. 4. LYRA <i>Souths</i>														
May	1st, 3 H. 56 M. A. M.	68, 35	69, 35	70, 35	71, 35	72, 35	73, 35	74, 35	75, 35	76, 35	77, 35	78, 35	79, 35	80, 35
June	1st, 1 H. 54 M. A. M.													
Fig. 5. AQUILA <i>Souths</i>														
July	1st, 1 H. 0 M. A. M.	38, 17	39, 17	40, 17	41, 17	42, 17	43, 17	44, 17	45, 17	46, 17	47, 17	48, 17	49, 17	50, 17
Fig. 6. FOMALHAUT <i>Souths</i>														
August	1st, 2 H. 1 M. A. M.	5, 11	6, 11	7, 11	8, 11	9, 11	10, 11	11, 11						
Septemb.	1st, 0 H. 4 M. A. M.													

Some of the Lesser Stars near the Great Star will show in this Manner when the Great Star is on the Meridian,



True Meridian Altitude of each Star for every Degree of Latitude from 60 Degrees North to 29 Degrees North, and the Altitudes of the Stars coming upon the Meridian before or after the First Day of the given Month. — The Planets shine with a

LATITUDE in NORTH.																				
D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.	D.
48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31	30	29	
s mentioned below, no Allowance being made for Dip and Refraction. — In the Latitude of 38 Degrees and to the Southward of the Horizon, and these Altitudes are accordingly marked North in the Table; but, the Altitudes of <i>Lyra</i> to the Northward of the South Point of the Horizon.																				
M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.	D.M.
1, 2	58, 2	59, 2	60, 2	61, 2	62, 2	63, 2	64, 2	65, 2	66, 2	67, 2	68, 2	69, 2	70, 2	71, 2	72, 2	73, 2	74, 2	75, 2	76, 2	77, 2
4, 4	55, 4	56, 4	57, 4	58, 4	59, 4	60, 4	61, 4	62, 4	63, 4	64, 4	65, 4	66, 4	67, 4	68, 4	69, 4	70, 4	71, 4	72, 4	73, 4	74, 4
1, 23	62, 23	63, 23	64, 23	65, 23	66, 23	67, 23	68, 23	69, 23	70, 23	71, 23	72, 23	73, 23	74, 23	75, 23	76, 23	77, 23	78, 23	79, 23	80, 23	81, 23
9, 35	80, 35	81, 35	82, 35	83, 35	84, 35	85, 35	86, 35	87, 35	88, 35	89, 35	89, 25	88, 25	87, 25	86, 25	85, 25	84, 25	83, 25	82, 25	81, 25	80, 25
49, 17	50, 17	51, 17	52, 17	53, 17	54, 17	55, 17	56, 17	57, 17	58, 17	59, 17	60, 17	61, 17	62, 17	63, 17	64, 17	65, 17	66, 17	67, 17	68, 17	69, 17
10, 11	11, 11	12, 11	13, 11	14, 11	15, 11	16, 11	17, 11	18, 11	19, 11	20, 11	21, 11	22, 11	23, 11	24, 11	25, 11	26, 11	27, 11	28, 11	29, 11	30, 11

A Ship, at Sea, January 1, (Sea-Day) in the Latitude of 45 Degrees North, by Dead Reckoning, having had no Observation of the Sun 3 Days, would be glad to use a Star if they knew the Star, by Sight, and the Time of its being on the Meridian.

ANSWER.

For the Month of January, ALDEBARAN is the Star to be used, and on the First Day of the Month it Souths at 9 Hours 37 Minutes P. M. or in the Evening, and in the Latitude of 45 Degrees North its true Meridian Altitude will be 61 Degrees 2 Miles South; and when ALDEBARAN is on the Meridian there will be three Stars bearing Westward of ALDEBARAN, as in Figure 1.

How to carry your Eye up to the Star in the Heaven, see the easy and quick Method in Page 27.

NOTE. — Although these Altitudes are fitted to each Star's Declination for the Year 1773, yet, these Altitudes will serve more than One Hundred Years, with needful Exchanges, for answering the Design of helping the Navigator to find out any One of these Stars in the Heavens.

[illegible]

THE TIME OF ITS BEING ON THE MOUNTAIN
AND
THE NAME OF EACH STATE

THE ALBANY COUNTY HISTORICAL SOCIETY

October	H. M.
November	H. M.
December	H. M.
January	H. M.
February	H. M.

1925

MAY 1963

Die 2. Anordnung ist Reibungslager

14-00000-1

1944

May 11. H. to M. A. M. 1890

1914-1915

241000

100

100-11001-0001

SECRET

Some of the other states near the coast

1950

1867

100-443887-100

To get the Star upon the Horizon Glas.

First, See by the adjoining Table, shewing the Time of the Southings of some of the biggest Stars, what Star is to be used for the given Month; and then find the Time of the Star's Southing on the Evening required; remembering to take out the Sun's Right Ascension for One Day sooner than the Date of the Sea-Day. Then find, in the Table, the Latitude in, by Dead Reckoning, at the last Noon, and see how much Meridian Altitude the Star will have in that Latitude, and mind whether the Meridian Altitude is from the North or South Point of the Horizon; then set the Vernier to that Meridian Altitude on the Arch. (*Read the Note at the Bottom of this Page*)

Secondly, Turn back the Screens; face that Point of the Horizon from which the Star's Meridian Altitude is reckoned; hold the Quadrant upright, the Arch downward; put your Eye close to the Lower Sight Hole in the Sight Vane; bend your Body upon your Hips a little to the Right and then to the Left, keeping the Horizon (which you see through clear Part of the Horizon Glas) as near as possible to the Middle of the clear Part of the Horizon Glas, and you will see the Image of the Star brush along upon the silver'd Part of the Horizon Glas: Having, now, got the Star's Image upon the silver'd Part of the Horizon Glas, steady your Body, and if the Star does not touch the Horizon which you see through the clear Part of the Horizon Glas, move the Index till you bring the Star to the Horizon, and take Notice how much the Altitude is.

To carry your Eye up to the Star.

The Star being brought to the Horizon, as directed by the last Rule, and the Vernier being at the Star's Altitude; then move

F 2

the

Note, The Fore Horizon Glas takes in about 7 Degrees of Altitude; therefore, when you are observing, if you make the Horizon of the Sea lie along the Middle of the Horizon Glas (as you ought always to do) you will have more than 3 Degrees of Altitude upon the Horizon Glas above the Horizon, and more than 3 Degrees below the Horizon.--- So, that, when you have set the Vernier to 3 Degrees too much of Altitude, you will bring the Star upon the silver'd Part of the Horizon Glas, below the Horizon, and near to the Bottom of the Glas; when you have set the Altitude 3 Degrees too little, you will then see the Star upon the silver'd Part of the Horizon Glas above the Horizon of the Sea and near the Top of the Glas.--- Therefore you may be sure of getting the Star, you seek for, upon the silver'd Part of the Horizon Glas, for these two Reasons,

First, There is no Star within 5 Degrees of the Star you want that is, nearly, so bright as the Star you seek for.

Secondly, It must be a very bad Dead Reckoning to be out 3 Degrees or 3 and a Half in the Latitude in.

the Index a little back, and keep raising the Arch, and at the same Time, gently, put back your Head so that you may keep Sight of the Star's Image at the Middle of the Horizon Glafs, on the silver'd Part, and nearly at the Edge of the silver'd Part; and as the Star goes up keep moving back the Vernier and raising the Arch very gently, and as gently putting back your Head 'till the long Line upon the Vernier is back at O, or Nought, upon the Arch; then look through the Middle of the clear Part of the Horizon Glafs, as close as possible to the Edge of the silver'd Part of the Horizon Glafs, and you will see the Star in the Heaven just as if it was joined on to its Image on the silver'd Part of the Horizon Glafs.

Having now found the Star in the Heaven, take good Notice how other Lesser Stars bear which lie near it, so that you may readily know the observed Star again; and, to help your Sight, look at the Figure of the Star and some Lesser Stars round the observed Star, in the Table between Page 26 and 27.

Thus the Industrious Seaman by this easy and quick Method, may find, in the Heaven, the Star he wants, and afterwards be able to know it again at first Sight.

To bring the Star down again to the Horizon, to observe its Meridian Altitude.

The Screens being turned back and the Long Line on the Vernier at O, on the Arch; put your Eye close to the lower Hole of the Fore-sight Vane, look directly at the Star, and see it through the clear Part of the Fore Horizon Glafs, and see the Star's Image at the same Time on the silver'd Part of the Glafs; move the Index or Vernier a little forward to part the Image, on the silver'd Part of the Glafs, from the Star seen through the clear Part; keep Sight of the Star's Image on the silver'd Part as you move the Index or Vernier from you; and, at the same Time, keep lowering the Arch as the Star comes down, 'till you have brought the Star down to the Horizon, which you see through the Middle of the clear Part of the Glafs; the Vernier shews the Altitude; and this Altitude being like the Altitude found by the End of the Rule for getting the Star upon the Horizon Glafs, Page 27, may be called another Proof of your having got the Right Star.

How to work an Observation by a Star,

To find the Latitude of the Ship.

The Navigator having found the Star in the Heaven, let the Meridian Altitude be observed and the true Meridian Altitude be found (See Page 34 of the Directions for the Use of the Quadrant) then,

Subtract

Subtract the true Meridian Altitude from 90 Degrees, and there remains the Star's true Meridian Zenith Distance.

With the Star's true Meridian Zenith Distance and it's Declination (taken from Page 25) find the Latitude in by the same Rules as are given by the Sun.

E X A M P L E.

A Ship at Sea *January* the 9th, (Sea-Day) 1772, by the Dead Reckoning at Noon, in the Latitude of 45 Degrees 15 Miles, or 45 Degrees, (taking no Notice of the odd Miles); having had no Observation of the Sun 3 Days, would be glad to use a Star, if they knew the Star by Sight and the Time of it's being on the Meridian, to find the Latitude of the Ship.

A N S W E R.

By the Table between Page 26 and 27 *Aldebaran* is the Star to be used for the Month of *January*; and in the Latitude of 45 Degrees it's Meridian Altitude will be 61 Degrees 2 Minutes from the South Point of the Horizon.--- By the Rule, Page 24, *Aldebaran* will South *January* 9th, Sea-Day (which is *January* the 8th by the Table of Right Ascension) at 9 Hours, 1 Minute P. M.

About a Quarter of an Hour before 9 P. M. I set the Vernier to 61 Degrees 2 Minutes upon the Arch; and, observing according to the Directions in Page 27 I found the Star upon the silver Part of the Horizon Glass just above the Horizon of the Sea; seen through the Middle of the clear Part of the Horizon Glass.--- The Star being brought down to the Horizon, the Vernier shew'd upon the Arch 61 Degrees 11 Minutes of Altitude.--- I then carried my Eye up to the Star in the Heaven according to the Directions in Page 27 and found it to be the Right Star.

By the Directions in Page 28 I observed for the Meridian Altitude and found it to be 61 Degrees, 23 Miles, the Eye being 15 Feet above the Water----- Required the Latitude in?

Dip 15 Feet - - - - - 4 Miles

Refraction for 61 Degrees 1 Miles

5 Miles

D. M.

Meridian Altitude observed - - - - - 61 23 South

Subtract Dip and Refraction - - - - - 5

Remains true Meridian Altitude - - - - - 61 18 South

From - - - - - 90

Subtract true Meridian Altitude - - - - - 61 18

Remains true Meridian Zenith Distance 28 42 South

Aldebaran's Declination - - - - - 16 2 North

The Zenith Distance and Declination being of a different Name, by Rule First, Page 15, add them together, the Sum is the Latitude in North, because the Declination is North.

44 44 North

The

The Log being taken off from last Noon to 9 this Evening, and Allowance being made for Lee-way and Variation the Ship has made 42 Miles Difference of Latitude Southerly, so that the Latitude in, by Dead Reckoning, is 44 Degrees, 33 Miles North; and by the Meridian Altitude of *Aldebaran* 44 Degrets 44 Miles. --- The Difference between these Latitudes or the Fault in Latitude, by Dead Reckoning, is 11 Miles.

How to mend the Reckoning, see the Rules, Page 33.

This Example as to the Way of finding the Star in the Heaven, and also of finding the Latitude in by the Star's Meridian Altitude being put down in this plain Manner, no other Example is necessary; the same Rules for finding the Latitude in, serves for a Star as well as for the Sun; only, remember, Stars have no Breadth, therefore, you add Nothing to a Star's Altitude for Breadth as you do to the Sun's Altitude for his Breadth.

How to find the Sun's Declination 'till the Year 1800.

The Earth goes round the Sun in 365 Days, 5 Hours, 48 Minutes, 55 Seconds; this Time is called the *Mean-Tropical Sun-Year*.--- The Common Year is 365 Days 6 Hours; but the odd 6 Hours are reckoned, only, once in 4 Years, and, then, One Day is added to *February* above its common Number, making *February* in that Year to have 29 Days, and then that Year will have 366 Days; and, for this Reason, that Year is called Leap-Year.

Because the Common Year and the Mean-Tropical-Sun Year are not, exactly, of the same Length, no one Set of Tables will shew the Sun's Declination truly for more than 4 Years, for which 4 Years they are properly made; therefore those Tables are not exact which shew the Sun's Declination for 16 Years to come, calling them Leap-Years, or First, Second, or Third after Leap-Year. --- 'Tis true the Sun alters his Declination not quite one Mile in 4 Years when he is near the Equinoctial, and makes the Greatest Difference of Declination on the same Day; but, as the Trouble of finding the Declination more truly is very little, and for the Sake of such Seamen who may desire to do it, here is a Table of the Alteration of the Sun's Declination which will make the Tables of the Sun's Declination in Page 2, 3, 4, 5, 6, 7, 8, 9, serve 'till the Year 1806.--- Those Seamen who do not choose to correct the Declination will observe Table I. shews that the Table of Declination in Page 2, 3, computed for 1773, serves, in the Common Way, for the Years 1777, 1781, 1785, 1789, 1793, 1797.--- The Like is to be understood of the Tables of Declination computed for the Years 1774, 1775, 1776.

TABLES

(31)

TABLES for finding the Sun's Declination 'till the Year 1800.

TABLE I							
1773		1774		1775		1776	
4	1777	4	1778	4	1779	4	1780
8	1781	8	1782	8	1783	8	1784
12	1785	12	1786	12	1787	12	1788
16	1789	16	1790	16	1791	16	1792
20	1793	20	1794	20	1795	20	1796
24	1797	24	1798	24	1799		

TABLE II

Shewing the Alteration of the Sun's Declination in 24 Years.

	4	8	12	16	20	24		4	8	12	16	20	24
	Miles	Miles	Miles	Miles	Miles	Miles		Miles	Miles	Miles	Miles	Miles	Miles
Jan.	1	0	0	1	1	1	July	8	0	1	1	1	2
	10	0	1	1	1	2		10	0	1	1	2	3
	20	0	1	1	2	3		20	0	1	1	2	3
	30	1	1	1	2	3							
Feb.	9	1	1	2	3	4	Aug.	7	1	1	2	3	3
	19	1	1	2	3	4		17	1	1	2	3	4
	29	1	1	2	3	4		27	1	1	2	3	4
March	10	1	1	2	3	4	Sept.	6	1	1	2	3	4
	20	1	1	2	3	4		16	1	1	2	3	4
	30	1	1	2	3	4		26	1	1	2	3	4
April	9	1	1	2	3	4	Oct.	6	1	1	2	3	4
	19	1	1	1	2	3		16	1	1	2	3	4
	29	1	1	1	2	3		26	1	1	2	3	3
May	9	0	1	1	2	2	Nov.	5	0	1	1	2	3
	19	0	1	1	1	2		15	0	1	1	2	2
	29	0	0	0	1	1		25	0	0	1	1	1
June	8	0	0	0	0	1	Dec.	5	0	0	0	0	1
	18	0	0	0	0	1		15	0	0	0	0	0
	28	0	0	1	1	2		25	0	0	0	0	1
								31	0	0	1	1	1

The Number taken from this Table is to be added to the Sun's Declination (taken from Tables in Page 2, 3, 4, 5, 6, 7, 8, 9.) when the Declination increases, but it must be subtracted when the Declination decreases.

The

The Use of the foregoing TABLES.

What will be the Sun's Declination at London, February the 9th, 1797?

In Table I. under 1773 is the given Year 1797, and on the Left of it stands the Number 24, meaning 1797 is 24 Years from 1773:— In Table II. against the 9th of *February* and under the Number 24 stands 4 Miles.--- Now because 1797 is found under 1773 take out the Sun's Declination for the 9th of *February*, 1773, which is 14 Degrees, 28 Minutes, and you see the Declination is Decreasing (the Declination on *February* the 10th being 14 Degrees 8 Minutes) therefore subtract the 4 Miles from the Declination on the 9th of *February*, 1773, and you will have 14 Degrees 24 Minutes the Sun's Declination for the 9th of *February*, 1797.

Sun's Declination the 9th of <i>February</i> , 1773	D. M.
Alteration in 24 Years, subtract	14 28
	4

Remains the Declination <i>February</i> the 9th, 1797	14 24
---	-------

Which is within Half-a-Mile of the true Declination 14 Degrees, 24 Minutes, 30 Seconds, computed by *Mayer's* Solar Tables; and the Truth is, that, the above Table of Variation of Declination may, sometimes, differ Half-a-Mile from the true Declination.

Note, When you want to correct the Declination for any Day not mentioned in Table II. use the Row of Numbers in Table II. which is nearest to the Day required.--- Thus,

Suppose you want to correct the Declination for the 12th of *April*.--- The 12 being nearer the 9 than the 19, use the Row of Numbers for the 9th of *April*.

To find the Sun's Declination for any Hour of the Day.

What is the Sun's Declination at London, March 11th, Sea-Day, 1773, at 3 Hours 25 Minutes P. M.?

This is *March* 10th, 3 Hours, 25 Minutes, by the Tables of Declination.

Declination at Noon, <i>March</i> the 10th	D. M.
Declination at Noon, <i>March</i> 11th	3 51 North
	3 28 North

Daily Alteration	23 Miles
------------------	----------

The Declination is Decreasing.----- Now, By the Rule of Three, If 24 Hours gives 23 Miles of Alteration, what will 3 Hours, 25 Minutes give?---- Answer, 3 Miles and a Quarter.

Declination at Noon, <i>March</i> the 10th	D. M.
Alteration of Declination in 3 Hours 25 Minutes,	3 51 North
Subtract, because the Declination is decreasing	3 3

Gives the Sun's Declination at <i>London</i> , <i>March</i> 11th,	3 47 1/2 N.
Sea-Day, at 3 Hours 25 Min. P. M.	3 48

Rules for mending the Dead Reckoning by an Observation of the Sun or of a Star.

Although the greatest Care be taken to mend the Course steered, by making proper Allowances for Lee-way and Variation, to find the Course made good, yet, the Latitude in by Account will often differ from the Latitude in by Observation, owing to one or, perhaps, more of these following Accidents, which commonly happen.

The different Rates of sailing between the Times of heaving the Log.

Bad Steerage, in letting the Ship Yaw or fall off.

Seas rolling with or against Her.

Sudden Squalls, when no Account can be kept.

Unknown Currents.

Upon the Account of these Causes, and many more, which often happen, the Navigator tries every Day to find the Latitude in by an Observation of the Sun at Noon, or of a Star, if he has had no Observation of the Sun at the Noon past; and when the Latitude by Dead Reckoning agrees with the Latitude by Observation (for it is the Latitude in by Observation that you must, always, call the true Latitude in) the Departure made and Longitude in, are supposed to be Right; but when the Latitude in by Dead Reckoning differs from the Latitude in by Observation, then the Departure is to be mended.

The Ship's Way, generally, is greater than the distance given by the Log: And as it is safer to have the Reckoning a-head of the Ship (that the Mariner may look out for the Land, and not make the Land before he is aware of it) when a great Sea sets after the Ship, one Mile over for every 10 Miles given by the Log is commonly allowed for the Heave of the Sea: If the Sea be against Her or athwart Her, her Way must be less than the Distance given by the Log.

The Fault in the Dead Reckoning often comes from a Current: And it is well known, that, the Trade Winds cause a great Current within their Bounds, particularly, between the Tropics where the Motion of the Current is, always, towards the West at about 8 or 10 Miles a-day; and near the Latitude of 30 Degrees North and 30 Degrees South it is likely that the Currents are made up of a Western Course and of One towards the Equator.

All Ships sailing between the Latitudes of 30 North and 30 South allow a Course and Distance each Day for the Current.

It is a very good Way (where you have Sea-Room) to run to the Latitude of your Port bound to when you have 2 or more Degrees of Longitude to make, and then steer East or West according as the Port lies, keeping a good Look-out for the Land.

To mend the Reckoning.

Take out, in a Traverse Table, the Difference of Latitude and Departure by Account made every 24 Hours, since your Departure from the Land; but if you have mended your Reckoning by an Observation since you departed from the Land, then take out the Difference of Latitude and Departure by Account made every 24 Hours since the last Time you mended the Reckoning by an Observation. Then,

When the Fault in the Latitude comes from a Current, If you have Reason to think the Fault is owing to a Current, find the Current's Setting and Drift, if possible; or allow such Setting and Drift as you judge reasonable, as a Course and Distance failed.--- Then,

If the Difference of Latitude thus mended will bring the Latitude by Account to agree with the Latitude in by Observation, the Departure, thus mended, you take for the true Departure.

Note, The Fault in Latitude, means, the difference between the Latitude in by Observation and the Latitude in by dead Reckoning.

If, after you have allowed for Lee-way, Variation, Currents and other Accidents, your Latitude in by dead Reckoning does not agree with the Latitude in by Observation, then the Reckoning must be mended by one of these two Rules.

The true Departure made to be found by one of these two Rules.

R U L E I.

Multiply the departure by Account by the true difference of Latitude, divide this Product by the difference of Latitude by Account, and the Quotient is the true departure.

R U L E II.

First, Multiply the difference of Latitude by Account into Itself, and multiply the departure by Account into Itself; add these two Products into one Sum.--- Then, multiply the true difference of Latitude into Itself, this Product subtract from the Sum of the other two Products, then extract the Square Root of this Remainder and you will have a new departure.

Secondly, Add the new departure to the departure by Account and take Half of the Sum for the true departure.

Note, The true difference of Latitude means, the difference between the last Latitude in by Observation, by which you mended the Reckoning, and the present Latitude in by Observation.

For

**** For the Sake of those Seamen that cannot extract the Square Root this Way, at the End of the Book there is an easy Rule for finding the *New Departure*.**

Note, When you have made no departure, you have made no difference of Longitude; therefore,

Your Longitude in will be the same as on the day you last mended the Reckoning.--- Put down the Latitude in by Observation and, so, the Reckoning will be mended.

Directions to know which Rule is to be used.

Directions about the First Rule.

When your departure by Account is Less than your difference of Latitude by Account.--- Then,

Subtract the departure by Account from the difference of Latitude by Account; what remains multiply by 6.--- If the Product is as much as the difference of Latitude by Account, or if the Product be More than the difference of Latitude by Account, in both these Cases use the First Rule.

Directions about the Second Rule.

First, When your departure by Account is More than your difference of Latitude by Account--- or,

Secondly, When your departure by Account is as much as your difference of Latitude by Account--- or,

Thirdly, When your departure by Account is Less than your difference of Latitude by Account, try this Third Case by the direction about Rule the First, whether you are, in this Third Case, to use the First Rule.--- If you are not to use the First Rule the Product mentioned in that direction will be less than the difference of Latitude by Account.--- Then,

In each of these three Cases use the Second Rule.

Note, If you have run so nearly East or West that your Course made Good is within Half-a-Point or Less than Half-a-Point of East or West, the Fault in the Departure will be so small that you need not mend the Departure by Account.

**** In working the Bearing and distance of the Port bound to**--- It is better to call the distance to the Port less by one or two days Run than what it comes out to, that you may have good Time to look out for the Land, and not be a-shore when you thought you had some Leagues to run.

You may know when the Ship is a-head, and when she is a-stern of her Reckoning by this

R U L E.

When the difference of Latitude by Account is less than the true difference of Latitude, the Ship is a-head of the Reckoning.

G 2

When

When the Difference of Latitude by Account is more than the True Difference of Latitude, then, The Ship is a-Stern of the Reckoning.

Examples at Length, for mending the Reckoning by an Observation.

EXAMPLE 1. --- *In a Current.*

A Ship from the Latitude of 39 Degrees 58 Miles North, by Observation, and 34 Degrees 15 Miles, Longitude, West, runs, S. W. by S. 82 Miles, then finds Herself, by Observation, in the Latitude of 38 Degrees 33 Miles North, but by Dead Reckoning, as below, in the Latitude of 38 Degrees 50 Miles; therefore She thinks there is a Current and, upon Trial, finds a Current setting S. by E. $\frac{1}{4}$ E. 3 Quarters of a Mile in one Hour: How much is the true Departure and the true Difference of Longitude made since the mending of the Reckoning, Yesterday at Noon?

By the Traverse Table, a S. W. by S. Course, 82 Miles Distance gives 68, 2 S. *Diff. Lat.* 45, 6 W. *Dep.* 1 D.M.

Latitude from	-	-	-	-	-	39 58 North
Difference of Latitude by Account	-	-	-	-	-	1 8 South

Subtract gives the Latitude in by Account	-	-	-	-	-	38 50 North
---	---	---	---	---	---	-------------

Latitude from	-	-	-	-	-	39 58 North
Latitude in by Observation	-	-	-	-	-	38 33 North

True Difference of Latitude	-	-	-	-	-	1 25
						60
						85 Miles

Latitude in by Account	-	-	-	-	-	38 50 North
Latitude in by Observation	-	-	-	-	-	38 33 North

Fault of the Latitude in by Account	-	-	-	-	-	17 Miles
-------------------------------------	---	---	---	---	---	----------

	<i>Miles</i>		<i>Miles</i>
Difference of Latitude by Account	} 68, 2 S.	Departure by Account	45, 6 W.
Current S. by E. $\frac{1}{4}$ E.			
Distance 18 Miles	} 17 S.		
(that is 24 Half Miles and 24 Quarter Miles) gives by the Table of Difference of Lat. and Departure.			
			6, 12
Difference of Latitude by Account, mended	} 85 S.	Departure mended	39, 5 W.

Now,

Now, Because the Difference of Latitude when mended, is just as much as the True Difference of Latitude, the Departure thus mended is the True Departure.

To find the true Difference of Longitude.

(See the Rule for it at the End of the Book)

	<i>D.M.</i>
Latitude from by Observation	39 58 North
Latitude in by Observation	38 33 North

1 25
60

True proper difference of Latitude 85 Miles

The Meridian Parts for 39 degrees, 58 Miles, are 2620 Miles

The Meridian Parts for 38 degrees, 33 Miles, 2510 Miles

True Meridional difference of Latitude - - - 110 Miles

The true departure made	39, 5 or 36
Multiply by the true Meridional difference of Latitude	110

360
36

The Product - - - - - 3960

Divide by the true proper difference of Latitude - - - - - Miles 85) 3960 (Quotient

340
560
510
50

46 Miles
differ. of
Longi-
tude

The Remainder, 50, being more than Half 85, the divisor, I take one Mile more for the Great Remainder, this makes the difference of Longitude to be 47 instead of 46.

For the Longitude in.

	<i>D.M.</i>
Longitude from	34 15 West
True difference of Longitude made	0 47 West
Longitude in	35 2 West

EXAMPLE

E X A M P L E II.

January the 26th, we took our departure from the *Lizard* which (by the Mariner's Kalendar) lies in the Isthude of 49 degrees 57 Miles North, longitude 5 degrees, 14 Miles West from the Meridian of *London*; having had no Observation till *January* the 29th at Noon, then found Ourselves in the latitude of 46 degrees 36 Miles North; we had made difference of latitude and departure every 24 Hours as below: How much is the true departure and the true difference of longitude made from the land we departed from?

Difference of Latitude and Departure by Account.

	Dif. Lat.		Dif. Lat.
	South		South
	Miles		Miles
<i>January</i> 27,	98, 4 South	32	South
28,	58, 5	17, 2	
29,	31, 8	69, 3	
Divide by 60)	188, 7 (3 Deg.	118, 5	
	180		
	8 Miles		

Difference of Latitude 3 Degrees 8 Miles, or rather 9 Miles because of the Seven Tenths--- *D.M.*

Latitude of the *Lizard* - - - - - 49 57 North

Difference of Latitude by Account - - - - - 3 9 South

Latitude in by dead Reckoning this day - - - - - 46 48 North

Latitude in by Observation this day - - - - - 46 36 North

Fault in the latitude in by dead Reckoning - - - - - 12 Miles

Latitude of the *Lizard* - - - - - 49 57 North

Latitude in by Observation To-day - - - - - 46 36 North

3 21
60

True difference of latitude made since *Jan.* 26, 201 Miles

To find the true Departure made.

Now, I look at the directions in Page 35 to know which Rule I must use to find the true departure made; and, because the departure by Account 118, 5 is less than the Difference of latitude by Account 188, 7 I try the direction about the First Rule.

1. From the difference of latitude by Account 189 Miles
Subtract the departure by Account - - - - - 119

The Remainder - - - - - 70

Multiply, as the directions says, by - - - - - 6

The Product - - - - - 420 Because

Because the Product 420 is greater than the difference of latitude by Account 189, therefore the direction about Rule the First says, the first Rule is to be used to find the true departure made.

Note, Had the above Product come out just as much as the difference of latitude by Account, the direction says, the first Rule must then have been used to find the true departure made.

For the Departure by RULE I.

	<i>Miles</i>
2. Departure by Account - - -	119
Multiply by the true difference of latitude	201
	<hr/>
	119
	2380
	<hr/>
The Product - - - - -	23919
Divide by 189, the difference of latitude by account.	
Divisor 189)	23919 (Quotient
	189
	<hr/>
	501
	378
	<hr/>
	1239
	1134
	<hr/>
	105 Remainder.

(126 M. is
the True
Depar.

The true departure may be called 127 Miles, because the Remainder 105 is more than half the divisor 189.

To find the True Difference of Longitude made.

	<i>D. M.</i>
Latitude of the Cape we took our Departure from	49 57 North
Latitude in by Observation this Day - - -	46 36 North
	<hr/>
	3 21
	60
	<hr/>

True proper Difference of Latitude - - - 201 Miles

	<i>Miles</i>
The Meridian Parts for 49 Degrees, 57 Miles are - -	3470
The Meridian Parts for 46 Degrees, 36 Miles are - -	3168
	<hr/>

True Meridional Difference of Latitude - - - 302

The

The True Departure made - - - - - Miles
 Multiply by the True Meridional Difference of }
 latitude - - - - - 302

254
 3810

The Product - - - - - 38354

Divide by the True proper Difference of la-
 titude - - - - - Miles 201) 38354 (Quotient
 201

1825 (190 M.
 1809 Dif. of
 Lon.
 164

The Remainder 164, being More than Half 201, the Divisor, one Mile more is to be taken for the Great Remainder, this makes the Difference of longitude 191 instead of 190.

For the Longitude in.

Longitude of the Cape we took our Departure from 5 14 West
 True Difference of longitude made 191 Miles or 3 11 West

Longitude in - - - - - 8 25 West

EXAMPLE for finding the True Difference of Longitude made when the Ship has run Due East or West.

(See the Note at the End of the Book)

A Ship from the Latitude of 49 Degrees 15 Miles North, by Observation, and Longitude 9 Degrees 23 Miles West, made Difference of Latitude and Departure in 4 Days as under, and then came into the Latitude, by Observation, of 49 Degrees 15 Miles North: How much True Departure and True Difference of Longitude has she made?

Difference of latitude and departure by Account.

Day	Dif. Lat.		Depart.	
	N.	S.	E.	W.
1, - -	59		36	
2, - -		40		21
3, - -		67	59	
4, - -	41		63	
<hr/>				
	100	107	158	21
		100		21
<hr/>				
		7	137	

The

The latitude come into, by Observation, 49 degrees 15 Minutes is just the same as the latitude sailed from by Observation, 49 degrees 15 Minutes, for this Reason the Ship has made her Course good due East, distance 137 Miles; so that the 7 Miles Southerly, in the difference of latitude by Account, is a Fault.--- The departure made 137 is the true departure.--- See the Note near the Bottom of Page 35.

To find the True Difference of Longitude made.

(See the Note at the End of the Book.)

To the Secant of the latitude sailed in 49 D. 15 M. 10, 18525
Add the logarithm of the departure made 137 Miles 2, 13672

From this Sum - - - - 12, 32197
Subtract 10 from the Index - - - 10

Remains the logarithm of the dif. of long. made 210 2, 32197

For the Longitude in. | D.M.

Longitude from - - - 9 23 West

Difference of longitude made 3 30 East

Longitude in - - - 5 53 West

E X A M P L E III.

February the 13th, at Noon, by an Observation we were in the Latitude of 44 Degrees 12 Miles North, Longitude in 11 Degrees 20 Miles West; and on February the 19th, by an Observation, at Noon, we were in the Latitude of 36 Degrees 54 Miles North: We made Difference of Latitude and Departure each Day as under, how much True Departure and True Difference of Longitude have we made since the last Mending of the Reckoning on February the 13th?

Difference of latitude and departure by Account.

	Dif. Lat.	Depart.
	South	West
	Miles	Miles
February 14,	63, 5	50, 4
15,	71, 6	66, 8
16,	58, 2	78, 3
17,	70, 3	64, 4
18,	74, 1	68, 2
19,	86, 7	78, 7
	424, 4	406, 8

Divide by 60) 420 (7 Degrees

Remains 4 Miles

H

Latitude

	<i>D. M.</i>
Latitude in <i>February</i> the 13th, - - -	44 12 North
Difference of latitude by Account - - -	7 4 South
Latitude in, by Dead Reckoning, this day -	37 8 North
Latitude in by Observation this day - - -	36 54 North
Fault in the latitude in by dead Reckoning - -	14 Miles
Latitude in, by Observation, <i>February</i> the 13th, -	44 12 North
Latitude in, by Observation, this day, - - -	36 54 North
	7 18
	60
True difference of latitude made since <i>Feb.</i> 13th, -	438 Miles

To find the True Departure made.

I look at the Directions in Page 35, to know which Rule I must use to find the True Departure made; and because the Departure by Account 406, 8 is lesser than the Difference of Latitude by Account 424, 4 I try the Directions about the First Rule.

The Difference of Latitude by Account 424
 Subtract the Departure by Account 407

The Remainder - - - 17
 Multiply as the Direction says, by - - 6

The Product - - - 102

Because the Product 102 is Lesser than the Difference of Latitude by Account 424; therefore I am not to use Rule the First. --- Then I look among the Directions about Rule the Second, and the Third Direction says, when the Product is less than the Difference of Latitude by Account, Rule the Second is to be used.

For the true Departure by Rule the Second.

1. Difference of Latitude by Account - - 424
 Multiply by Itself - - - 424

1696
 848
 1696

The First Product - - - 179776

2. Departure

(43)

2. Departure by Account - - - 407
Multiply by Itself - - - 407

2849
16280

The Second Product - - - 16280
The First Product - - - 179776

345425
The Sum of first and second Products

3. True Difference of Latitude - - - 438
Multiply by Itself - - - 438

3504
1314
1752

The Third Product - - - 191844
To be subtracted from the Sum of the other two Products.

The Sum of the First and Second Products 345425

4. The Third Product subtract - - 191844

153581
The Remainder

The Square Root of this Remainder to be extracted.

5. The Remainder 153581 (391 Miles Departure
Square Root.

9
First Divisor 69) 635
621

781
Second Divisor 781) 1481
781

700 Remainder

The Departure may be called 392 because the Remainder 700
is above Half the last Divisor 781.

6. Departure by Account - - - 407 Miles
New Departure - - - 392 Miles

799
Sum of Both Departures - - -
Divide by - - - 2

399 and a Half, or
The Half is the True Departure - - - 400 Miles.
H 2 Such

Such Seamen as cannot extract the Square Root in the Manner just now shewn, they may find the New Departure by the Rule at the End of the Book, Thus

1. To logarithm of Departure by Account 467 - 2, 60959
Add 10 to the Index - - - - - 10

This Sum call, S, - - - - - 12, 60959
Subtract logarithm of different latitude by Account 424 - 2, 62737

Look for this Number among the Tangents, and it }
gives 43 Degrees 50 Minutes - - - } 9, 98222

2. From the Sum called, S, - - - - - 12, 60959
Subtract the Sine of 43 Degrees 50 Minutes- - 9, 84046
2, 76913

Remains the logarithm of the Distance run since Feb. }
13th, at Noon - - - - - 588 Miles

3. The Distance 588
True difference of latitude 438

Their Sum - - - 1026 logarithm 3, 01115

Distance - - - 588
True difference of latitude 438

Their Difference - - - 150 logarithm 2, 17609

Sum of logarithms - - - - - 5, 18724
Divide by - - - - - 2

Half the Sum of the logarithms - - - 2, 59362

Gives the Number 392, the Departure required, the same as is found by the other Rule.

The true difference of longitude made since the 13th of February and the longitude now in, are to be found just in the same Way as in Page 37. The Difference of longitude made will be 529 Miles Westerly, and the longitude in 20 Degrees 9 Miles West.

EXAMPLE IV.

March the 24th, at Noon, by an Observation, we were in the Latitude of 44 Degrees, 45 Miles North, Longitude 14 Degrees 17 Miles West, and on March the 27th, by an Observation, at Noon, we were in the Latitude of 44 Degrees 12 Miles North; We have made

made Difference of Latitude and Departure, by Account, each Day as mentioned below: What is the True Departure and True Difference of Longitude made since the last mending of the Reckoning, on March the 24th?

Difference of Latitude and Departure by Account.

	Diff. Lat.		Depart.
	North	South	East
	Miles	Miles	Miles
March 25, -		17, 4	22, 3
26, -	33, 6		19, 7
27, -		62, 3	83, 3
	33, 6	79, 7	125, 3
		33, 6	
		46, 1	

	D. M.	
Latitude in March the 24th, - - - -	44 45	North
Difference of Latitude by Account - - - -	46	South
Latitude in by Dead Reckoning this Day - - - -	43 59	North
Latitude in by Observation March the 24th, - - - -	44 45	North
Latitude in by Observation this Day - - - -	44 12	North
True Difference of Latitude made since March 24th, - - - -	33	Miles
Latitude in by Observation this Day - - - -	44 12	North
Latitude in by Dead Reckoning this Day - - - -	43 59	North
Fault in the Latitude in by Dead Reckoning - - - -	13	Miles

To find the True Departure made.

I look at the Directions in Page 35 to know which Rule I must use to find the Departure made, and because the Departure by Account 125, 3 is More than the Difference of Latitude by Account 46, 1 therefore by the First Direction about Rule the Second, I am to use Rule the Second to find the True Departure made.

For the True Departure by Rule the Second.

1. Difference of Latitude by Account	46	
Multiply by Itself - - - - -	46	
	276	
	184	
The First Product - - - - -	2116	2. Depart-

(46)

2. Departure by Account - - - 125
Multiply by Itself - - - 125

625
250
125

The Second Product - - - 15625
The First Product - - - 2116

The Sum of First and Second Products 17741

3. True Difference of Latitude - - 33
Multiply by Itself - - - 33

99
99

The Third Product - - - 1089
To be subtracted from the Sum of the other Two Products.
The Sum of First and Second Products 17741

4. The Third Product subtract 1089

The Remainder - - - 16652

The Square Root of this Remainder to be extracted.
Square Root.

5. The Remainder 16652 (129 Miles Departure

Divisor 22) 66
44

Divisor 249) 2252
2241

11 Remainder.

The Remainder is of no Value because it is not above Half the
Last Divisor 249

6. Departure by Account 125 Miles
New Departure - - - 129 Miles

Sum of both Departures - - 254
Divide by - - - 2

The Half is the true Departure 127 Miles

To

To find the New Departure by the Rule at the End
of the Book.

1. To Logarithm of Departure by Account 125 - 2, 09691
Add 10 to the Index - - - - - 10

This Sum call, S, - - - - - 12, 09691
Subtract Log. of Diff. Lat. by Account 46 - - - 1, 66276

Among the Tangents is 69 D. 48 M. for - - - 10, 43415

2. From the Sum called, S, - - - - - 12, 09691
Subtract the Sine of 69 D. 48 M. - - - - - 9, 97243

Remains the Log. of the Distance run since *March* }
the 24th, 133 Miles } - 2, 12448

3. The Distance - - - 133
True Difference of Latitude 33

Their Sum - - - - - 166 Log. 2, 22011

Distance - - - - - 133
True Difference of Latitude 33

Their Difference - - - 100 Log. 2, 00000

Sum of Logarithms - - - - - 2, 22011
Divide by - - - - - 2

Half the Sum of the Logarithms - 1, 11005

Gives the Number 122, the Departure required, the same as is
found by the other Rule.

The True Difference of Longitude made since *March* the 24th,
and the Longitude now in, are to be found just in the same Man-
ner as before. --- The Difference of Longitude made will be 177
Miles Easterly, and the Longitude in is 11 Degrees 20 Miles
West.

E X A M P L E V.

November the 13th, By Observation we were in the Latitude of
36 Degrees 11 Miles North, Longitude 27 Degrees 4 Miles West. ---
This Day, November the 18th, by Observation our Latitude is 11
33 Degrees 30 Miles North; we have made Difference of Latitude
and Departure by Account each Day as mentioned below: How much

is the True Departure made since the last mending of the Reckoning on November the 13th?

Different Latitude and Departure by Account.

		Dif. Lat.		Depart.	
		N.	S.	E.	W.
November	14,	-	54, 3	2	49, 5
	15,	-	76, 9	3	66, 3
	16,	44, 8	-	50, 1	-
	17,	35, 4	-	-	47, 6
	18,	-	97, 6	-	35, 2
		88, 2	228, 8	50, 1	198, 6
			80, 2		50, 1
			148, 6		148, 5

To find the true Departure made I look at the Directions in Page 35 to know which Rule I must use to find the Departure made, and because the Departure by Account 148, 5 may be said to be as much as the Difference of Latitude by Account 148, 6, there being only one Tenth of a Mile Difference, therefore by the Second Direction about Rule the Second I am to use Rule the Second to find the true Departure made.

Having already put down, in a very plain and full Manner, two Examples of the Work of finding the true Departure by the second Rule, the Mariner can very easily work this Example himself; I shall therefore give only the Answer to every particular Thing, that he may know when his Work is right.

Latitude in by Dead Reckoning 33 Degrees 42 Miles North---True Difference of Latitude made 161 Miles--- Fault in the Latitude in by Dead Reckoning 12 Miles--- New Departure 136 Miles--- True Departure made 142 $\frac{1}{2}$ Miles--- Difference of Longitude made 175 Miles Westerly--- Longitude in 29 Degrees 59 Miles West.

** Take Notice how small the Fault is in the Departure by Account in the Fourth Example. The Fault is only two Miles although there is a Fault of thirteen Miles in the Latitude in by Dead Reckoning--- The Reason of the Smallness of this Fault in the Departure by Account is, that, the Course made good (North about 70 Degrees Easterly) is so near the East Point; and the Fault would have been just the same had the Course made good been so near the West Point.--- Had the Course been more Easterly than 70 Degrees, the Fault in the Departure by Account would have been less than Two Miles.--- This proves what the Note says (See the Note at the End of the Directions about using the Second Rule in Page 35; this Note says) When the Course made good is within Half-a-Point of East or West, the Fault in the Departure will be so small that you need not mend the Departure.

EXAMPLE

EXAMPLE VI.

How to mend the Reckoning by an Observation with a Star.

NOTE, The same two Rules for mending the Reckoning are to be used with a Star as were used with the Sun; therefore one Example will be enough.

January the 4th, 1772, By an Observation, at Noon, we were in the Latitude of 49 Degrees 10 Miles North, Longitude in 6 Degrees 45 Miles West. On January the 9th, it being a bright Star-Light Night, and having had no Observation since the 4th, we should be very glad to observe the Meridian Altitude of a Star to mend the Reckoning by that Observation if we were sure of using the right Star --- [See Page 29] --- ALDEBARAN is the Star proper for January; and about 9. P. M. observed the Meridian Altitude of Aldebaran 61 Degrees 23 Miles South, the Eye being 15 Feet above the Horizon. The Latitude of the Ship by this Observation, as found in Page 29, is 44 Degrees, 44 Miles North. We have made Difference of Latitude and Departure each Day as mentioned below: How much True Departure and True Difference of Longitude have we made since the last mending of the Reckoning on January the 4th?

Difference of Latitude and Departure by Account.

	Dif. Lat.		Depart.
	North	South	West
January, 5,	- 47		14,
6,		61, 6	30, 2
7,		75,	39, 7
8,		77,	18, 6
9,		68, 4	32,
From Noon } to 9 P. M. }		41, 7	16, 9
			<hr/>
			323, 7
			47,
			<hr/>

Divide by 60) 276, 7 (4 Degrees
240,

Remains - - 36 Miles or 37
Miles because of the 7 Tenths.

D. M.

Latitude in by Observation January the 4th, - - 49 10 North
Difference of Latitude by Account made since - - 4 37 South
Latitude in by Dead Reckoning at 9 P. M. - - 44 33 North

Latitude in by Observation <i>January</i> the 4th, -	D. M.
Latitude in at 9 P. M. this Evening by Observation of <i>Aldebaran</i> .	49 10 North
	44 44 North
True Difference of Latitude made since <i>January</i> 4th,	4 26 North
	60
	266 Miles
Latitude in by <i>Aldebaran</i> at 9 P. M. this Evening	44 44 North
Latitude in by dead Reckoning at 9 P. M. this Evening	44 33 North
Fault in the Latitude in by Dead Reckoning	11 Miles

To find the True Departure made,
I look at the Directions in Page 35 to know which of the two Rules I must use to find the True Departure made; and because the Departure by Account 151, 4 is less than the Difference of Latitude by Account 276, 7 I try the Directions about Rule the First.

1 From the Difference of Latitude by Account	Miles
Subtract the departure by Account	277
	151
The Remainder	126
Multiply, as the direction says, by	6
The Product	756

Because the Product 756 is greater than the difference of Latitude by Account 277, therefore the direction about Rule the First says, the First Rule is to be used to find the true departure made.

For the Departure by Rule First.

2. Departure by Account	151
Multiply by the true difference of latitude	266
	906
	906
	302

The Product - - - - - 40166

Divide by the difference of } Divisor 277 40166 (Quotient
Latitude by Account }

	277
	1246
	1108
	1386
	1385

Remainder 1

Having

145 Miles true departure,

Having now got the true difference of Latitude and the true departure made since *January* the 4th, the last Time the Reckoning was mended; the true difference of Longitude made is to be found just in the same Way as before.--- The difference of Longitude is 213 Miles Westerly, the Longitude in 10 degrees 18 Miles West:

EXAMPLE for the Note at the Top of Page 35.

A Ship from the Latitude of 42 degrees 17 Miles north, Longitude 50 degrees 13 miles West, made in 3 days the difference of latitude and departure as below; when by an Observation she found herself in the Latitude of 43 degrees 17 miles north: How much true departure and true difference of Longitude did she make?

Difference of Latitude and Departure by Account.

Dif. Lat.		Depart.	
N.	S.	E.	W.
1,	-	52	17
2,	-	28	59
3,	-	29	42
<hr/>		<hr/>	
81	28	59	59
28			59
<hr/>		<hr/>	
53			00
<hr/>		<hr/>	

D. M.

Latitude from - - - - - 42 17 North
Difference of Latitude by Account - - - - - 53 North

Latitude in by dead Reckoning this day 43 10 North

Latitude in by Observation - - - - - 43 17 North
Latitude from by Observation - - - - - 42 17 North

True difference of Latitude made - - - - - 1 00

Latitude in by Observation - - - - - 43 17 North
Latitude by dead Reckoning - - - - - 43 10 North

Fault in the Latitude in by dead Reckoning 7 Miles

The Ship has made just as much Easting as Westing, and subtracting one from the other nothing remains, therefore she has made no departure.--- She has made no difference of Longitude, therefore she is in the same Longitude that she was in at the last Observation, that is 50 degrees 13 Miles West.--- I put down her Latitude now in, by Observation, 43 degrees 17 Miles, and then the Reckoning is mended.

Of

Of the Variation of the Compass.

The Variation of the Compass means the Number of degrees or Points that the North Point of the Compass stands on the East or West Side of the true North Point of the Horizon. In some Places the Variation is East, in other Places it is West, in many Places there is no Variation.

The Variation, at the same Place is, always, altering; in some Places it grows more Easterly, in other Places it grows more Westerly: How far the Variation will go, or what is the Cause of the Variation no Person can, certainly, tell.

About the Middle of the English Channel the Variation has altered, nearly, one degree in Seven Years: In the Year 1756 the Variation was 19 degrees West, this Year, 1773, it is nearly 22 degrees West.

In running from the English Channel to the Southward you alter the Variation, almost, every day; therefore the Navigator ought, every day, to find the Variation of his Compass: And, for the Sake of those Seamen who have not a better Compass, I here shew them how to find the Variation near enough for Practice at Sea.

FIRST METHOD.

An easy and quick Way, every Day at Noon, with a common Wooden Dish-Compass, only, to find how the Variation is, and whether it is East or West.

Lay a Scale or Strait Ruler upon the Compass dish right over the Lubber's Line and over the Middle or Top of the Brass Center or Brass Head in the Middle of the Compass Card, to divide the Circle or Round of the Compass dish into two equal Parts; and mark each Side of the dish.

Cut two Bits of Stick about one Inch long and one Quarter of an Inch broad and about a Quarter of an Inch thick.—About a Quarter of an Inch from the End of each Piece with a fine Awl or a sewing Needle, bore a Hole to drive a Pin through for fastening one Piece, upright, at the Mark on one Side of the dish and the other Piece of Stick, upright, at the Mark on the opposite Side of the dish.—In the Middle of the Top of each Piece put a small Pin upright. Now make a Bowline Knot in a Thread and put the Bite of it over one Pin, stretch the Thread over the Compass to the other Pin, strain it just taut and belay it.—Now,

To find the Variation,

When you find it Twelve o'Clock by the Sun, set down the Compass full in the Sun (but not near any Iron) and make the Shadow

Shadow of the Thread lie upon the Middle of the Brass Head in the Center or Middle of the Compass Card. --- Then, see what Point or degree upon the Compass Card, reckoning from the North Point, the Shadow of the Thread lies upon; this Point or degree upon which the Shadow lies, shews how much the Variation is; and if the North Point of your Compass is on the West Side of the Thread's Shadow, the Variation is Westerly, but if the North Point of the Compass is on the East Side of the Thread's Shadow the Variation is then Easterly.

(See how to allow the Variation upon any Course by the Note at the Bottom of Page 24)

Note. You should always observe the Variation by same Compass you steer by.

* * If there be Nails in your Compass Box; or any Iron in the Binnacle, you ought not to think your Compass will stand as it should; because, Iron near the Compass draws the Needle and the Card out of its proper Station.

The Second Method of finding the Variation of the Compass, by full and plain Directions how to observe an Amplitude by a Common Wooden-Disk Compass, and, also, how to work the Amplitude.

How to observe an Amplitude.

When you see the Lower Limb of the Sun about Half the Sun's Breadth above the Horizon then take his Bearing from the North Point of your Compass thus,---

First have ready one of the dark Glasses of your Quadrant; or a bit of a Glass smoked over a Candle, to hold before your Eye when you observe.--- Then

Set your Compass right in the Sun and turn the Lubber's Line towards the Sun; now move the Compass Box 'till the Two upright Pins, about which the strained Thread is fastened, seem to divide the Sun into two equal Parts, then directly see what degree or Point of the Compass Card, reckoning from the North Point, stands against the Lubber's Line: This degree or Point is the Bearing of the Sun from the North Point of your Compass, and you may call it the *Magnetical Amplitude*.

To compute or find the True Amplitude.

The True Amplitude, commonly, means, how many degrees or Points the Sun rises from the true East or sets from the true West Point of your Horizon.--- The Greatness of the Amplitude is according to the Latitude of the Ship and the Sun's declination:

When

When the Sun's declination is North, he rises on the North Side of the true East Point of the Horizon and sets as much (as may be said in finding the Variation for Practice at Sea) on the North Side of the true West Point of the Horizon; and when the Sun's declination is South he rises on the South Side of the true East Point and sets as much on the South Side of the true West Point. When the Sun has no declination he rises at the true East Point and sets on the true West.

To find the True Amplitude from the East or West.

1. Take the Latitude in, and the Sun's declination at that Noon which is near to the Time you observe the Amplitude.
2. Subtract the Latitude in from 90 degrees and keep the Remainder. Take out the Sine of the Sun's declination and add 10 to the Index; from this Sum subtract the Sine of the Remainder mentioned above, and what now remains will be the Sine of, what is commonly called, the Sun's true Amplitude, that is, the distance of the Sun's Center from the true East Point of the Horizon at Sun rising, and from the true West Point at Sun-setting. The Mariner's Compass shews the true Amplitude thus. Seek the Sun's declination down the Side of the Table of Amplitudes upon that Page that has your Latitude in (to the nearest degree) at the Top, and carry your Finger from the declination right athwart that Leaf till you come under your Latitude in, these Numbers will be the Sun's True Amplitude required.

How to work the Magnetical Amplitude and the True Amplitude to find how much the Variation is and whether it is East or West.

1. To get the Sun's distance from the true North Point of the Horizon at his Rising and Setting.--- This is what I shall call the Sun's True Amplitude.

When the Sun's declination is North subtract the Amplitude above found from 90 degrees, the Remainder is the True Amplitude from the North.

When the Sun's declination is South add the Amplitude above found to 90 degrees, the Sum is the True Amplitude from the North.

When the Sun has no declination, he rises at the East and sets on the West Point, then his True Amplitude will be 8 Points or 90 degrees from the North.

2. The Sun's distance from the true North Point of the Horizon or (what I call) the True Amplitude at Sun-rising mark, (it) East and at Sun-setting mark this True Amplitude West.---

Now,

Now, take the Magnetical Amplitude, (what you observed with the Compass) and the True Amplitude just now mentioned, and always subtract the Lesser from the Greater, what remains shews how much the Variation is. — And

3. If the True Amplitude is bigger than the Magnetical Amplitude, the Variation is of the same Name as the True Amplitude; but if the True Amplitude be lesser than the Magnetical Amplitude the Variation is of a contrary Name to the True Amplitude.

EXAMPLE

August the 17th, 1737, about 6 Hours 30 Minutes P. M. observed the Sun's Magnetical Amplitude or his Bearing from the North Point of the Compass 70 Degrees. — The Latitude in at the Noon past was 40 Degrees 53 Minutes North, but by the Log-Board we have gone about 22 Miles to the Northward since Noon, this makes the Latitude in at the Time of taking the Amplitude 41 Degrees 15 Miles North. — The Sun's Declination at Noon past 9 degrees 39 Miles north. The Variation of the Compass is required.

To find the True Amplitude by Logarithms.

From	W. 70	D. M.
Subtract the Latitude in at the Time the Magnetical	90	
Amplitude was taken	41 15	
Remainder	48 45	
To the Sine of 9 Degrees 39 Minutes, the Sun's	9. 22434	
Declination at the nearest Noon, add to the	10	
Add to the Index	19. 22434	
From this Sum	9. 87612	
Subtract the Sine of the Remainder 48 D. 45 M.	9. 34822	
Remains the Sine of 12 Degrees 53 Minutes		
True Amplitude from the West Point of the		
Horizon		

By the Table of Amplitude in the Mariner's Compass.

It is the Practice at Sea to use, what is called the nearest Degree, therefore, under 41 degrees of Latitude and against 10 degrees of declination is 13 degrees 18 Miles, or 13 degrees Amplitude from the True West.

The

The Navigator may use which of these two Ways he likes best. Half a degree in the Amplitude is not minded in Practice at sea, therefore I shall work the following Examples with the Amplitudes found by the Mariner's Compass.

To find how much the Variation is, and whether it is East or West.

For the True Amplitude from the North Point of the Horizon.

Because the Sun's declination is North, the Amplitude from the West 13 degrees, must be subtracted from 90 degrees.

From	Degrees.
90	
Subtract the Amplitude from the West	13

Remains the True Amplitude from the North 77 West

The True Amplitude is named West, because the Magnetical Amplitude was taken at Sun-setting.

For the Variation.

From the True Amplitude	Degrees
Subtract the Magnetical Amplitude observed	N. 77 West
Remains the Variation	7 West

The Variation is of the same Name (West) as the True Amplitude, because the True Amplitude is bigger than the Magnetical or observed Amplitude.

The whole Work of this Example being put down in so plain and easy a Manner, I shall give the Answers, only, to other Examples, because the Navigator may easily work them Himself.

EXAMPLE II.
Latitude in 50 Degrees 48 Miles North; Sun's Declination 22 Degrees 3 Miles North; Magnetical Amplitude observed at Sun-rising North 73 Degrees Easterly: What is the Variation?

A N S W E R.

Amplitude from the East 96 Degrees and 1 or 37 Degrees. The declination being North, the Amplitude from the East to be subtracted from 90 degrees; this gives the True Amplitude N. 33 degrees Easterly. --- Variation 20 degrees West; the Variation is of a contrary Name to the True Amplitude because the True Amplitude is less than the Magnetical or observed Amplitude.

EXAMPLE

E X A M P L E III.

Latitude in 6 Degrees North; Sun's Declination 17 Degrees, 8 Miles North; Magnetical Amplitude observed at Sun-rising North 70 Degrees East: What is the Variation?

A N S W E R.

Amplitude from the East 17 Degrees.-- The Declination being North, the Amplitude from the East to be subtracted from 90 Degrees; this gives the true Amplitude North 73 Degrees Easterly.-- Variation 3 Degrees East: The Variation is of the same Name as the true Amplitude, because the true Amplitude is bigger than the Magnetical or observed Amplitude.

E X A M P L E IV.

Latitude in 8 Degrees 15 Miles South.-- Sun's Declination 23 Degrees 29 Miles South.-- Magnetical Amplitude observed at Sun-setting North 114 Degrees West: What is the Variation?

A N S W E R.

Amplitude from the West 23 Degrees 45 Miles or 24 Degrees.-- The Declination being South, the Amplitude from the East to be added to 90 Degrees; this gives the true Amplitude North 113 Degrees 45 Miles, or 114 Degrees West.-- Variation 0 or Nothing.

E X A M P L E V.

Latitude in 26 Degrees 9 Miles South;-- Sun's Declination 23 Degrees, 7 Miles North.-- Magnetical Amplitude observed at Sun-setting North 47 Degrees West: What is the Variation?

A N S W E R.

Amplitude from the West 29 Degrees.-- The Declination being North, the Amplitude from the East to be subtracted from 90 Degrees; this gives the true Amplitude North 61 West.-- Variation 12 Degrees West.-- The Variation is of the same Name as the true Amplitude, because the true Amplitude is bigger than the Magnetical or observed Amplitude.

E X A M P L E VI.

Latitude in 48 Degrees 20 Miles North.-- Sun's Declination 13 Miles South.-- Magnetical Amplitude observed at Sun-rising North 112 Degrees East: What is the Variation?

A N S W E R.

By the Mariner's Compass one Degree of Declination South in the Latitude of 48 gives 1 Degree 29 Miles, or 89 Miles True Amplitude

Amplitude from the East towards the South ; and 15 Miles of Declination being one Fourth of one Degree, give 22 Miles of True Amplitude from the East towards the South ; these 22 Miles being one Fourth of 89 Miles, the true Amplitude answering to one Degree of Declination : But 22 Miles being less than Half of one Degree, I cast off the 22 Miles and say the Sun rises due East therefore his true Amplitude is North 90 Degrees East.---Variation 22 Degrees West.--- The Variation is of a contrary Name to the true Amplitude, because the True Amplitude is less than the Magnetical or observed Amplitude.

The Mariner's knowing the Variation of his Compass wherever the Ship is, at Sea, is of very great Use ; therefore, many Seamen will not be sorry for having a more plain Way of working an Amplitude than they can meet with in any other Book ; and the short Way of knowing the Variation without being at the Trouble of working for it, may please other Navigators.

Note, For a little Expence there may be fitted to a Brass Compass two small Brass Pins (to be taken away when they are not wanted, these Brass Pins) having an Eye in the Middle of the Top of each Pin to receive a Thread or Twine through them.--- The Pins to stand upright and as the two Bits of Stick mentioned in Page 52, to observe, by this Brass Compass, the Sun's Amplitude at his Rising or Setting, and to find the Variation at Noon, instead of using a Common Wooden-Dish Compass for such Purposes.

To find the Setting and Drift of a Current.

When there is a smooth Sea and hule Wind, heave out the Boat, taking into her 3 or 4 Hands and a Compass, Log Line and a Half Minute Glass, and a small Warp about 100 Fathoms or more long, having a large Pot or Kettle fastened to the End of the Warp : the heavier the Pot or Kettle is the better.

When you are off from the Ship cast over your Pot or Kettle and let it sink 100, or 120 Fathom if you have Line enough, then heave the Line fast about the Stem or Fore-Threshold, then the Boat will be brought up and secure to ride as if she was at Anchor.--- Now,

Cast over your Log, turn up the Glass and as you veer out the Log-line, see the Drift of the Log with your Compass ; the Compass shows you which Way the Current sets, and the Length of the Log-line run out tells how much the Current drives in one Hour.--- But, take Notice, that, although the Boat seems to ride or lie still, yet, she is found, by Experience, to drive ; therefore, to the Drift given you by the Log, add, as is always done, as follows,--- If the Line the Boat rides by be Sixty Fathoms make the

Drift

Drift given by the Log one Third Part bigger; if the Line be 80 Fathoms make the Drift given by the Log one Fourth bigger; if the Line be 100 Fathom make the Drift one Fifth bigger.

The bigger or heavier the Pot or Kettle is the less the Boat will drive.

Every Navigator wishing to make a good Land-fall will find it necessary to mind, very carefully, the following Things.

1. He should keep a due Proportion between the Glass and the Log-line.

2. He ought to know what Lee-way the Ship makes the whole Twenty-four Hours.--- He must allow for Currents, Swells and Driving Seas.

3. He should very often (and, in some Places, it is very Necessary every Day to) find the Variation of his Compass.

4. If he has not had an Observation of the Sun, he ought to get an Observation, if he can, that Night with a Star; and as often as he finds the Latitude by Dead Reckoning does not agree with the Latitude in by Observation, he should mend the Reckoning.

5. His Quadrant, giving the Sun's Altitude to one Mile, ought to be good, and the Glasses made to stand truly in their Places.

6. His Compass ought to be good.--- There should be no Nails in the Box, nor should Iron be any where near the Compass.--- The Navigator would do well to carry with him a Pair of small Magnets to touch the Compass at Sea, when it may be found necessary.

As these Things, when carefully practiced, will make the Navigator able to give a good Account where the Ship is, I shall beg leave to offer a few useful Directions about such of these six Things as have not been mentioned in the First Part of this Book.

First--- About the Log-line and Glass.

Many Ways have been mentioned to find how far a Ship runs in one Hour, but the Log-line and Half-Minute Glass is mostly used by the English.

Captain NORWOOD, in 1635, measured one Degree upon the Earth and found it to be 69 Miles and a Half or 367000 Feet; and, because Sixty Miles make one Sea-Degree, the One Sixtieth Part of 367000 Feet is about 6117 Feet, and this is the Length of one Sea-Mile.

The Number of Feet that go to one Knot must be the same Part of one Mile, as the Half of one Minute, or 30 Seconds, is of one Hour---

Hour.--- The Half of one Minute, or 30 Seconds, is, the One Hundred and Twentieth Part of one Hour; and 51 Feet (found by dividing 6117 by 120) is, very nearly, the One Hundred and Twentieth Part of 6117 Feet, the Length of the Sea-Mile; and, therefore, 51 Feet should go to one Knot; But, as it is better to have the Reckoning a-head of the Ship, for this Reason, only 50 Feet may be called the right Length of each Knot.

This TABLE shews what ought to be the Length of a Knot according to the Seconds that your Glafs runs.

When the Glafs runs Seconds	The Length of a Knot ought to be	
	Feet	Inches
23	39	4
24	40	—
25	41	8
26	42	4
27	43	—
28	44	8
29	45	4
30	46	—
31	47	8
32	48	4
33	49	—

That the Log-line may hold its Distance between each Knot--- Before the Line is marked it ought to be well seasoned by Stretching, and I have known the Line to have been well boiled afterwards, before it was marked.

Note, You may make this Table go higher than 33 Seconds and lower than 23 Seconds by allowing one Foot 8 Inches for one Second.

*** In heaving the Log, the Line should be veered off the Reel: If the Log, of itself, is left to turn the Reel the Log will come Home and then there must be a Fault in the Distance.--- When the Log is brought Home by a Sea or a Swell the Navigator is to make such Allowance for it as he judges necessary.--- [See Page 33.]

To try how many Seconds a Glafs runs by what is, commonly, called a Pendulum.

The Glafs may often falter, therefore it ought to be tried often, thus,

In a Piece of Twine about 4 Feet long make a Loop to hang on a Nail, then take a small Marling Spike or a Pump Bolt--- Suppose

pose you use a Pump Bolt--- Then fasten the Twine to the Bolt so, that, from the End of the Loop to the Middle of the Bolt it may be just 3 Feet 3 Inches and 2 Tenths of an Inch.--- Drive a small Nail in any Place (the nearer a Midship the better) where the Bolt may swing freely; chalk a line about 4 Feet long right down under the Nail, then hang on the Bolt and make it swing.--- Every Time the Bolt passes by the chalk'd line it will be a true Second of Time however fast or slow the Bolt moves; and every Time the Bolt passes from the chalked line to the utmost Swing, it will be Half-a-Second.

Note, If you want to measure your Glas in Blowing Weather, when the Ship has a great Motion--- then

Use what is called a Half Second Pendulum.

This means a Pendulum that will pass by the chalked line once in Half a Second of Time.--- The Length of this Pendulum, counting from the End of the Loop to the Middle of your Piece of Iron, must be 9 Inches and 8 Tenths of one Inch.--- Every Time your Piece of Iron or Lead (the Pump Bolt may be too long for a Half Second Pendulum) passes by the chalked Line you call that Half-a-Second of Time.

When your Glas faulters,

The Distance, the Difference of Latitude and the Departure will all Three be wrong; but the Course made good will not be wrong.

If you have made the Distance between each Knot upon the Log-line according to any one of the Numbers in the Second Row of the Table in Page 60; then, when your Glas does not run the Seconds, in the First Row of the Table, answerable to such Number of Feet between each Knot; if you do not care to alter the Log-line you may use this

Rule to find the Right Distance run and the Right Difference of Latitude and Departure made.

Multiply the Distance run by the Number of Seconds the Glas ought to run, then divide the Product by the Number of Seconds the Glas now runs, the Quotient gives the right Distance run.--- With the Course made good and the right Distance, find, in the Table of Difference of Latitude and Departure, the Right Difference of Latitude and Departure.

EXAMPLE

E X A M P L E.

My Log is surind 41 Feet 8 Inches to a Knot, and upon trying my Glass it only runs 23 Seconds; but by the Table, Page 60, it ought to run 25 Seconds: I have made since I tried the Glass 214, 4 Miles Northing and 156 Miles Easting, which gives my Course made good North 36 Degrees Easterly, Distance 265 Miles: What is the right Distance run and the right Difference of Latitude and Departure made?

Wrong Distance	Miles 265
Multiply by the Seconds the Glass ought to run	25
	1325
	530
	6625

Divide by the Seconds the Glass does run 23 (6625) 288 Miles
right Distance.

	46
	298
	184
	185
	184
	1

Now Course 36 Degrees, right Distance 288 Miles, in the Tables of Difference of Latitude and Departure, gives as below,

	Diff. Lat.	Depart.
100 Miles Distance, 30, 9	58, 8	31, 8
100 Miles Distance, 30, 9	58, 8	31, 8
88 Miles Distance, 71, 2	51, 7	16, 9
288 Miles Distance, 233, 0	169, 9	169, 9

So that the Course made good is N. 36 East, Right Distance 288 Miles, Right Difference of Latitude 233 Miles North, Right Departure 169 Miles East.

* By *Hafelden's Seaman's Daily Assistant*, or *Moore's New Daily Assistant*, you may take out, at once, your Difference of Latitude and Departure for any Distance so far as 200 Miles.

2. About Lee-way.

A plain and easy Way of knowing the Lee-way is thus.—Upon the Rail right over the Stern-Post or Rudder-Head, draw a Line right Fore and Aft.—Then make a Half Compass, upon a Piece of

Lead, and nail it upon the Rail with the Point east -- Now, let the Ship's Wake, and as many Points as the Wake bears from the Fore and Aft Line, so many Points Lee-way she makes from the Course she steers.

EXAMPLE

A Ship steering E. N. E. $\frac{1}{2}$ E. with her Starboard Tack on Board, I set the Wake by the Half Compass on the Rail, and found the Wake to bear 2 Points to Windward of the Fore and Aft Line of the Half Compass, therefore she makes her Way upon the N. E. $\frac{1}{2}$ E., which is 2 Points to Lee-ward of the E. N. E. $\frac{1}{2}$ E., the Course she steers.

It is hardly needful to tell the experienced Seaman, that the more Sail a Ship has upon her the less Lee-way she makes: And also, that the more Aft-sail she has the more she will lay to the Wind.

Note. The Lee-way ought carefully to be taken very often, but especially at every Alteration of Sail; and it would be of very great Service to every Artist on Board, if the Officer of the Watch would cause the Lee-way to be set down on the Log-book. This not being done I may, safely, say is one Cause that there is often so great Difference in the reckonings on Board.

If the Mariner should not be allowed to sail a Half Compass upon the Rail, he might carry in his Pocket a small Half Compass drawn on a Bit of Board or on Part of the Cover of a useless Book, and hold it down upon the Rail, and so for the Wake, for his own Use, when he finds it necessary.

The Manner of allowing for Currents, Swells and Drift, See has been mentioned in Page 39 about mending the Reckoning.

3. How to find the Variation of the Compass

This is shown in Page 152.

4. How to find the Latitude in by a Star, and how to mend the Reckoning.

This has been shewn.

5. The Nature of HADLEY'S Quadrant is fully shewn, by plain and easy Words, to the meanest Capacity, by the Book mentioned in the Paper opposite the Title Page of this Book.

Sixth;

157. **Of How to touch your Compass.**

A Mathematical Instrument-maker will let you have, in a Case, a Pair of Artificial Magnets about 9 Inches long, though the longer and bigger they are, the better.--- Each Magnet has a North Pole and a South Pole, the North Poles are marked; and you must let the North Pole of one Magnet lie beside the South Pole of the other Magnet, in the Case. The warmer and drier the Place is, you keep the Magnets in, the better.

Take a Piece of Board, about Half an Inch thick and about 8 Inches long and 8 Inches broad, bore a Hole through the Middle of it big enough to take the Brass Head in the Middle of your Compass Card.--- Take your Compass Card out of the Box, put the Brass Head on the Card into the Hole in the Board, and let a Hand put his Finger gently upon the Hole in the Brass Head to keep the Card fast upon the Board.--- Now,

Take a Magnet in each Hand and draw the South Pole of one Magnet, hard, over the North Point of the Needle of your Card, and, at the same Time draw the North Pole of the other Magnet, hard, over the South Pole of the Needle of your Card.--- Do this Eight or Ten Times and your Compass will be touched very strongly if your Magnets are good.--- Then, put your Magnets into the Case, the North Pole of one Magnet to lie beside the South Pole of the other Magnet.

Now, If your's is a Wooden Dish Compass, so that you must take out the Bottom of the Dish to get the Card out.--- After you have touched the Needle and put the Card in the Dish again, then, put in the Bottom of the Dish as before, scrape a little Resin or Rosin to some Tallow, mix them well together and pay the Seam of the Dish with your Finger or a Knife.--- Or the Seam may be payed with Pitch.

To mend the Reckoning by the Tables of Difference of Latitude and Departure.

* * This Way is near enough for one or two Days run and when the Difference of Latitude and Departure made is not too big for the Tables.--- But when you must divide the Difference of Latitude and Departure by 4 or 5 or a bigger Number to use the Tables, the Departure found by the Tables will not be true, therefore, it is, then, better to use the Rules in Page 34.

To find the True Departure made by Rule First.

1. Find, in the Tables of Difference of Latitude and Departure, the Course to the Difference of Latitude and Departure by Account.

2. Under the same Course in the Row of Difference of Latitude, find the true Difference of Latitude made, the Departure belonging to this Difference of Latitude is the True Departure.

Note. When the Difference of Latitude and Departure by Account is too big for the Tables, divide the Difference of Latitude and Departure and True Difference of Latitude made by 2, then you must multiply the True Departure by 2.

E X A M P L E. [See Page 38]

The Difference of Latitude by Account 189 Miles, the Departure by Account 118, 5 or 119 Miles, True Difference of Latitude made 201 Miles: How much is the True Departure?

This Difference of Latitude and Departure is too big for the Tables in the Mariner's Kalendar, therefore I divide each by 2.

Diff. Lat.	Dep.	True Diff. Lat.
189	119	201
2	2	2
<hr/>		
94, 5	59, 5	100, 5

These Numbers, also, are too big, therefore I divide by 4 instead of 2.

189	119	201
4	4	4
<hr/>		
47, 2	29, 7	50, 2

Now, The Difference of Latitude and Departure in the Tables the nearest to 47, 2 and 29, 7 is 47, 5 and 29, 7 under 32 Degrees the Course.--- Then under 32 Degrees I look down the Row of Difference of Latitude to find 50, 2 the true proper Difference of Latitude, the nearest to it is 50 Miles, the Departure belonging to this 50 Miles is 31, 3; now, because I divided the True Difference of Latitude made by 4, I multiply this Departure 31, 3 by 4, gives 125, 2 Miles for True Departure; this is 2 Miles too little.

To find a new Departure by Rule Second.

1. In the Tables of Difference of Latitude and Departure, find the Difference of Latitude and Departure the nearest to your Dis-

ference of Latitude and Departure by Account, and mind the Distance for this Difference of Latitude and Departure.

2. To this Distance seek the difference of Latitude which is the nearest to your true difference of Latitude, and take out the departure belonging to this distance and difference of Latitude, which departure will be the new departure sought.

EXAMPLE [See Page 41]

The Difference of Latitude by Account 424, 4 Miles, the Departure by Account 406, 8 Miles, True Difference of Latitude 438 Miles: How much is the New Departure?

	Dif. Lat.	Dep.	True Dif. Lat.
	424, 4	406, 8	438
Divide by	8	8	8
	<hr/> 53, 0	<hr/> 50, 8	<hr/> 54, 7

Under 44 degrees and against 73 Miles is 52, 5 difference of Latitude and 56, 7 departure which is near 53 the difference of Latitude by Account and 50, 8 the departure by Account.--- Then under 42 degrees against 73 Miles distance in the Row of Latitude is 54, 2 Miles which is the nearest in the Tables to the true difference of Latitude 54, 7: The departure belonging to this difference of Latitude 54, 2 is 48, 8 Miles.--- This 48, 8 or 49 Miles I must multiply by 8 because I divided the true difference of Latitude by 8, and the Product is 392 Miles, the new departure, [See Page 43] which happens to be the same as is found by the exact Rule.

At the *cheapest Price* possible, the Seaman has, in this Book, useful Knowledge in so plain and easy a Manner, that, it may be very readily understood by the lowest Capacity, that knows any Thing about a Ship's Reckoning.

That I might not put the Navigator to an unnecessary Charge or Expence, I have left out the following Things--- A JOURNAL --- How to work the Bearing and distance of any Place from the Ship.--- How to measure the Course and distance between any two Places upon a plain draft and upon a Mercator's draft.--- These Things are left out, because they are so plainly done already, in HASLDEN's *Seaman's Daily Assistant*, and in MOORE's *New Daily Assistant*; and these Books, especially HASLDEN's, is used by many Seamen.

My Hearty (and I may, justly, say my chief) desire has been to make this Book truly useful and easy to Seamen; and I hope, that every Seaman will find, if it be but, only, one Quarter of the Pleasure in using this Book, that I have had in writing it for
His 176: My

Useful Directions for Ships coming into the *English Channel* from the *Westward* and *Southward*.

The Benefit arising to one Vessel, only, by the Use of the following Remarks and directions will be a sufficient Excuse for putting them in this Book.

Seldom a Winter passes but we hear of Homeward-Bound Ships finding themselves, before they expected it, either upon the South Coasts of *Ireland* or driven into *St. George's Channel*; and we often hear of others having been embayed and quite lost in *Bristol Channel*. [See the Advertisement at the Bottom of Page 20]--- These Misfortunes seem to be owing either to the Navigator's not being able to make proper Use of an Observation of the Sun or of a Star, or when he comes into Soundings, in thick Weather with a strong Southerly or South-West Wind (which often happens in the Winter) he does not make an Allowance in his Course and distance for the draught into *St. George's Channel*, which draught being increased by a stiff Gale from the South or South-Westerly, causes a strong Northerly Current as has been often found by able Navigators.

1. Get into the Latitude of 49 degrees 25 Miles North and keep as nearly as you can in this Latitude; have your Lead going, and when you find 100 or 120 Fathoms of Water, you are, then, at the outer Edge of the *English Bank* or what is commonly called Soundings.

2. From 100 or 120 Fathoms in the Latitude of 49 degrees 25 Miles, keep in this Latitude by steering E. S. E. (your Compass having about two Points West Variation, hereabouts, (this Year 1774) till by the Log you have run about 80 Leagues, then you may haul to the Northward to make the Land.--- But here you must mind well what has been mentioned above, that; in these Soundings there has been often found a strong Northerly Current driving at the Rate of about one Mile an Hour, partly owing, perhaps, to the draught into *St. George's Channel*, but especially if it has blown or does blow hard from the Southern Quarter.--- This Current may be the Reason for some Navigator's saying, they generally shorten their Log or use a longer Glass coming into the Channel than when they are bound out, and, if they were not to do so they find the Ship would be much a-head of her reckoning.--- The great danger of this, especially in the Winter Time when the days are short and stormy, every Seaman, acquainted with the Coasts of our Channel, well knows.

From what has been now mentioned if you have a stiff Gale to the Westward of the South it may be best to make some Allow-

ance in the Course steered, and instead of an E. S. E. steer nearly Half-a-Point more Southerly, or about S. E. by E. $\frac{1}{2}$ E. to keep in the Latitude of 49 degrees 25 Miles North.

Another Reason for being cautious is, (if it be true what some Navigators say) that, in some drafts the Latitude of the Lizard and other Head Lands is laid down 10 Miles more to the Northward than their true Latitude is; the True Latitude of the Lizard is 49 degrees 57 Miles North, its true Longitude from *London* (by Observation of Doctor *Maskeelyne*, the Royal Astronomer at *Greenwich*) 5 degrees 38 Miles West.--- The Latitude of the Light House of *St. Agnes* (one of the *Scilly* Islands) 49 degrees 56 Miles North, Longitude 7 degrees, 9 Miles West from *London*.

*** *Scilly* Islands lie better than 60 Leagues from the Western Edge of the Soundings.

3. If when you come into Soundings from the Western Ocean and you have not had an Observation either of the Sun or a Star for several days and Nights, so that you cannot be sure that you are in the Latitude of 49 degrees, 25 Miles North, then, if you can, get Ground in 100 or 120 Fathoms; when you have done this keep the Log and Lead going every Hour and steer E. S. E., but steer S. E. by E. $\frac{1}{2}$ E. if you find the Current spoken of before or if it blows hard from the South-westerly Quarter, 'till you have run (from 100 or 120 Fathoms your First Soundings) about 50 Leagues and shoaled your Water, by degrees, to about 65 Fathoms.--- Now, you must mind, because the Soundings on both Sides of *Scilly* have been, often, found to be very near alike, you cannot be quite sure whether you are, now, to the Northward or Southward of *Scilly*, therefore, to be sure on which Side of the Islands you now, are, steer a S. S. W. Course, and as you go to the Southward you will deepen your Water from 65 to 70 Fathoms and better; and when you have got 70 Fathoms and better of Water it is a Sign that the Channel is open and, that, you are now clear of the danger of running a shore on *Scilly* or into *St. George's* Channel, therefore now alter the S. S. W. Course to E. by S. and run about 20 or 25 Leagues and then you will be within *Scilly* Islands, so that you may now haul to the Northward and make bold with our own Coast let the Weather be how it will, for it is better to do so than to deal with the French Coast; for should you deal with the French Coast you may, perhaps, fall in with the Islands of *Jersey* or *Guernsey*, the *Caskets* or other very dangerous Places, and so hazard the Loss of both Ship and Lives.

4. When you come from the Southward from *Spain*, *Portugal*, or the Bay of *Biscay* in thick Weather, be very careful how you come in with the Channel.--- You will often have coarse Soundings,

ings, and if you are near *Uphant* you will have Gravel with small Stones.--- The Ground near *Uphant* is much steeper than the Edge of the Western Bank or Soundings.--- For when you come into Soundings from the Southward, having the Channel open, and if you steer to the Northward to make the Land's End or the Lizard, in running 8 or 10 Leagues you will go from 100 Fathoms to 75 or 70 Fathoms Water, thus lessening your Soundings 25 or 30 Fathoms in 8 or 10 Leagues: But when you come into Soundings from the Westward you may run 25 or 30 Leagues and not alter your Soundings above 25 Fathoms.--- By these last Remarks about shoaling your Water you may give a good Guess whether you have the Channel open.

** In coming up the Channel, when you are a-breast of the Lizard, you will have about 50 Fathoms of Water, and off the Start about 45 Fathoms.

The following is the Rule mentioned in Page 37.

To find the True Difference of Longitude made since your Departure from the Land or since the last Time the Reckoning was mended by an Observation,

By WRIGHT's (commonly call'd MERCATOR's) Sailing.

R--U--L--E.

The first Time you mend the Reckoning take out the Meridional Parts for the Latitude of the Cape you took your departure from and the first latitude in by Observation, and find the Meridional difference of latitude between them.

The Second Time and all other Times of mending the Reckoning take out the Meridional Parts for the latitude in by Observation, by which Observation you last mended the Reckoning, and the present latitude in by Observation, and find the Meridional difference of latitude between them.--- Then,

Multiply the true departure made by the True Meridional difference of latitude, divide this Product by the true proper difference of latitude, and the Quotient is the true difference of longitude you seek for.

The Difference of Longitude is East or West just as your Departure is named.

The following is the Note mentioned in Pages 40, 41.

Note. When you have made departure only, and not made any difference of latitude, that is, when you have run due East or due West,--- Then

Add together the Secant of the latitude in and the logarithm of the departure made, then subtract 10 from the Sum of the Indexes, the Remainder is the logarithm of the difference of longitude made.

This

This is the Rule mentioned in Pages 35, 44, 47.

For finding a new Departure.

Those who do not understand the Square Root by common Arithmetick may find the departure by this

R U L E.

1. Take out the logarithm of the departure by Account and add 10 to the Index and call this Sum by the Name of Letter S.— From this Sum, called S, subtract the logarithm of the difference of latitude by Account, then look among the Tangents for the degrees and Minutes answering to this Remainder, this Remainder may be called the False Course.

2. From the Sum called S, subtract the Sine of the False Course, there will remain the logarithm of the distance run since the departure from the land, or since the last Time the Reckoning was mended.— Take out the Number for this logarithm of distance.

3. Add the distance and true difference of latitude together and take out the logarithm for this Sum.— Then subtract the true difference of latitude from the distance; take out the logarithm for this Remainder and put this logarithm under the other logarithm and add the logarithms together, take half the Sum of the logarithms, look the Number for this Half Sum of the logarithms and you will have the departure you seek for.

The Work of this Rule is not hard nor long, as may be seen in Pages 44, 47: so many Words being used on Purpose, only, for mentioning every Thing very fully.

E I N D S.

